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**EXPERIMENTAL AERODYNAMIC CHARACTERISTICS
OF MISSILES WITH SQUARE CROSS SECTIONS**

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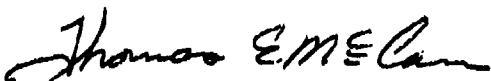
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THE AUTHORS WISH TO EXPRESS THEIR APPRECIATION TO APPROXIMATELY 30 US AIR FORCE ACADEMY CADETS FOR THEIR ASSISTANCE IN OBTAINING, RECORDING, AND ANALYZING MUCH OF THE DATA IN THIS REPORT. IN ADDITION, WE ARE INDEBTED TO OUR COLLEAGUE MAJ. THOMAS BOLICK WHO PROVIDED THE SOFTWARE SUPPORT, AND THE US AIR FORCE ACADEMY AERO LABORATORY TECHNICIANS WHO PROVIDED THE TECHNICAL SUPPORT.

FORWARD

A SERIES OF QUANTITATIVE AND QUALITATIVE TESTS WERE CONDUCTED TO EXPAND THE AERODYNAMIC DATA BASE OF SQUARE CROSS-SECTION MISSILES. QUANTITATIVE TESTS INCLUDED MEASURING FORCES AND MOMENTS ACTING ON SQUARE MISSILES, AND MEASURING FLOWFIELD PRESSURES ON THE LEEWARD SIDE OF SQUARE MISSILES AT VARIOUS CONFIGURATIONS AND ORIENTATIONS IN A SUBSONIC WIND TUNNEL. FORCE AND MOMENT DATA IS PRESENTED SHOWING THE EFFECTS OF VARIATION IN BODY CORNER RADIUS, NOSE AND FIN SHAPES, PITCH ANGLE, AND ROLL ANGLE. FLOWFIELD PRESSURE AND CROSSFLOW VELOCITY DATA ARE PRESENTED FOR MISSILES OF VARIOUS PITCH ANGLES, ROLL ANGLES, BODY CORNER RADII, AND FINENESS RATIOS (LENGTH TO WIDTH RATIO). IN ADDITION, FLOWFIELD DATA IS SHOWN ALONG THE AXIAL LENGTH OF A SQUARE MISSILE.

QUALITATIVE TESTS INCLUDED PHOTOGRAPHING TUFT GRIDS IN THE FLOWFIELD AND PHOTOGRAPHING OIL SHEAR STRESS PATTERNS ON THE SURFACE OF VARIOUS MISSILES. THESE QUALITATIVE PHOTOGRAPHS ARE PRESENTED FOR VARIOUS MISSILE CONFIGURATIONS AND ORIENTATIONS.

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INTRODUCTION

During the last several years there has been increasing interest in rectangular or square cross-section bodies for missiles and submunition applications. This interest is due primarily to the increased packing efficiency that results from the rectangular shape as compared to missiles with circular cross sections. This packing efficiency gain is due to two factors: (1) the ease of packing rectangular modular components and (2) greater usable volume for a given frontal area. What must be determined, however, is whether this well-recognized packing advantage is outweighed by possible detrimental aerodynamic effects.

Unfortunately, only a limited amount of aerodynamic information exists which could support preliminary design or analyses of missiles with square cross-sections, especially those requiring moderate amounts of maneuverability. These limited studies include the two-dimensional work by Polhamus (Ref. 1 and 2) which investigated with the aerodynamic characteristics of several non-circular 2-D cylinders with the longitudinal axis normal to the freestream flow. Drag, side-force and pressure coefficient variation with Reynolds number was investigated with a primary stability predictions for fuselages at high angles of attack. Additional work was conducted by Clarkson (Ref. 3) on a rectangular cross-section forebody at an angle of attack between 45 and

90 degrees. This work concentrated on investigating side-force and pressure coefficient variation with Reynolds number and the reasons for the failure of simple cross-flow theory to predict behavior at high angles of attack. Finally, Knoche (Ref. 4) and Schneider (Ref. 5) briefly investigated the aerodynamic characteristics of bodies with rectangular cross sections. In general, however, there is little in the technology base to support design of three dimensional applications.

To assist in overcoming this deficiency, the Air Force Armament Laboratory and the Air Force Academy conducted a research program to analyze the aerodynamic characteristics of missiles having square cross-sections. The first phase of the program was concerned with measuring the experimental forces and moments on square missiles for a wide range of geometries, orientations, and flow conditions. Photographic documentation of surface oil-flow patterns which define the shear stress distribution along the missile surface were also recorded. The second phase of the program was concerned with detailed flow-field measurements. Pressure measurements were recorded in various planes of the flow-field and pressure contours were mapped of the flowfield. In addition, tuft grid photographs were taken to describe the flow-field. This report presents results from each of the two phases of the research program which began in November 1979 and extended through December 1982.

II DESCRIPTION OF EXPERIMENT

All testing was conducted at the Air Force Academy Aeronautics Laboratory using the subsonic wind tunnel. Basically, two types of quantitative tests were conducted: force and moment measurements and flowfield pressure measurements. The force and moment measurements were made using an internally mounted steady state strain gage balance in a free stream velocity of 360 ft/s and atmospheric pressure. The flowfield measurements were made using a 7-hole pressure probe mounted on a three-directional traverse mechanism. This data was taken at a free stream velocity of 100 ft/s and atmospheric pressure. In addition, two types of qualitative tests were conducted: tests to record oil flow patterns on the surface of various shaped missiles, and tests using a tuft grid matrix to record cross-flow velocity patterns on the leeward side of the missile. Oil surface tests were conducted at 360 ft/s, and the tuft grid tests were conducted at 100 ft/sec.

1. Wind Tunnel (Ref. 6)

The U.S. Air Force Academy subsonic wind tunnel is a continuous flow closed circuit facility which has a test section of two feet by three feet and is capable of operation between Mach numbers of 0.04 and 0.35 at atmospheric pressure. At the maximum operating condition, the tunnel is capable of operation at a unit Reynolds

number of 1.6 million per foot. The nominal turbulence level of the test section has been measured at 0.12% based upon an overall spacial average for a velocity range of 60 to 150 fps. A general schematic is presented in Figure 1.

2. Wind Tunnel Models

Two sets of models were tested in the experiment: one set with fineness ratio equal to 8 (fineness ratio is defined as the length to width ratio of the missile), and another set with fineness ratio equal to 16. A description of each set of models follows.

A. Models of Fineness Ratio 8

The various model components used in this investigation are shown in Figures 2 and 3. These figures depict the four bodies, each with a different cross-section corner radius; the two noses, a blunt-tangent ogive, and pointed-tangent ogive, and one each of the three sets of fins that were used. All components were made of aluminum. As illustrated by the figure, the four body cross-sections ranged from square (B1) to round (B4) and were defined by a normalized body corner radius ratio (r/b) r being the radius of the corners and b being the diameter of the circular missile. The values investigated were 0.0, 0.1, 0.2, and 0.5. These

bodies are depicted in Figures 2 and 3 as I, II, III, and IV respectively. Each body section was 12 inches long and had a width (diameter) of 2 inches. The blunt tangent ogive nose (N1) shown in Figure 2 was 3 inches in length and had a bluntness of 0.69. The pointed-tangent ogive nose (N2) was 4 inches long. The three sets of fins were designated F1, F2, and F3, and had aspect ratios (based on exposed semi-span) of 0.47, 0.67, and 0.34 respectively. Fins F1 and F3 had an exposed semi-span of 1.25 inches and lengths of 4 inches and 6 inches respectively. Fin F2 had an exposed semi-span of 1.5 inches and a length of 3 inches. The four bodies, two noses, and three sets of fins were used to make various configurations of the missile model. An assembled model, is shown in Figure 4. As can be seen from this figure, the fins are mounted in a standard cruciform arrangement at the corners of the body.

B. Models of Fineness Ratio 16

The model components of the missiles of fineness ratio 16 are shown in Figure 5. This figure deposits five bodies, each with a different cross-section corner radius, and two noses, a blunt-tangent ogive and a pointed-tangent ogive. These components were also made of aluminum. Fins were not used on these high fineness ratio missiles. As illustrated in the figure, five bodies were tested and ranged from perfectly square (designated missile 1) to

perfectly round (designated missile 5). The normalized body corner radii (r/b) values of these five bodies were 0.0, 0.1, 0.2, 0.3, and 0.5. The bodies are depicted in Figure 5 as 1, 2, 3, 4, and 5, respectively. Each of these bodies were 20 inches long and had a width of approximately 1.5 inches. The two noses, the blunt tangent ogive and the pointed tangent ogive, were 3" and 4" in length, respectively.

3. Force and Moment Balance

A .75 inch diameter, steady state, internally mounted strain gauge balance was used to measure the force and moment components on the square-shaped missile bodies in three axes. The balance is capable of measuring forces to an accuracy of 0.1 percent. Forces and moments were recorded in either the body or wind axis systems with the axis origin at the balance center. Figure 6 illustrates positive loads recorded by the balance and the positive force directions in the body and the wind axis systems with respect to the square missile.

4. Flowfield Test Measurement Apparatus

A seven hole pressure probe developed at the United States Air Force Academy was used to measure pressures on the leeward side of various missile configurations (Ref 7). The Seven-hole probe

is capable of recording total pressure, static pressure, and fluid velocity in all three axes and has been calibrated for incompressible fluid flows up to 80 degrees, measured from the flow directions to the probe axis. Figure 7 depicts the seven-hole probe used in the experiment. As shown in the figure the probe is approximately 0.1 inch in diameter. To position the probe on the leeward side of the missile body, a three-directional traverse mechanism was used. For all flow field measurements taken, the traverse mechanism was used and was positioned to place the probe in a plane behind the model. Figure 7 shows the traverse mechanism.

5. Data Acquisition and Processing

All data was acquired using an Automated Data Acquisition System and a PDP 1145 computer. Raw data from either the strain gage balance or the seven-hole pressure probe were input into computerized data reduction programs which computed the force and moment coefficients illustrated in Appendix A or total pressures and velocity cross flows illustrated in Appendix C. Graphical plots were obtained using the PDP 1145 computer and a Tektronix 4662 Interactive Digital Plotter.

6. Qualitative Tests Apparatus

To enhance our understanding of the flow field pressure and velocity patterns obtained by the pressure probe, tuft grid tests and oil flow tests were also conducted. Tuft grid tests were conducted by placing a grid of wool tufts in the flow field and then photographing the tuft patterns. Appendix D shows the tuft grid photographs. Oil flow tests were conducted by painting the models black and then spraying white oil in a light speckled pattern on the models. The oil was a mixture of titanium dioxide, oleic acid and 90 weight transmission oil. After the tunnel was brought up to the appropriate speed and the oil migrated sufficiently over the surface of the models to define the shear stress distribution, photographs were taken of the oil flow patterns. Appendix E shows the photographs of various oil flow patterns.

III TEST RESULTS

Results of the tests performed are illustrated in Appendices A through E. A short description of each test is presented at the beginning of each Appendix. Analysis of the data is left for the reader, although several papers (Ref. 8-10) have been published which analyze various aspects of the data. A description of the test data presented in each appendix is described below.

Appendix

Description of Tests Results

- A Force and Moment Graphical comparisons of various missile configurations. Data is presented in either the body or wind axes format.
- B Tabular print-outs of Forces and Moments measured on various missile configurations. Data is presented in either the body or wind axes format.
- C Quantitative flowfield data. Data includes both plots of total pressure contours and cross-flow velocity vectors in a plane of the flow on the leeward side of the missile. Plane of data is perpendicular to the free stream velocity.
- D Photographs of tuft grid patterns describing the flow field on the leeward side of the missile.
- E Photographs of oil flow patterns on the surface of missiles tested in various configurations.

USAF A 2x3 SUBSONIC WIND TUNNEL

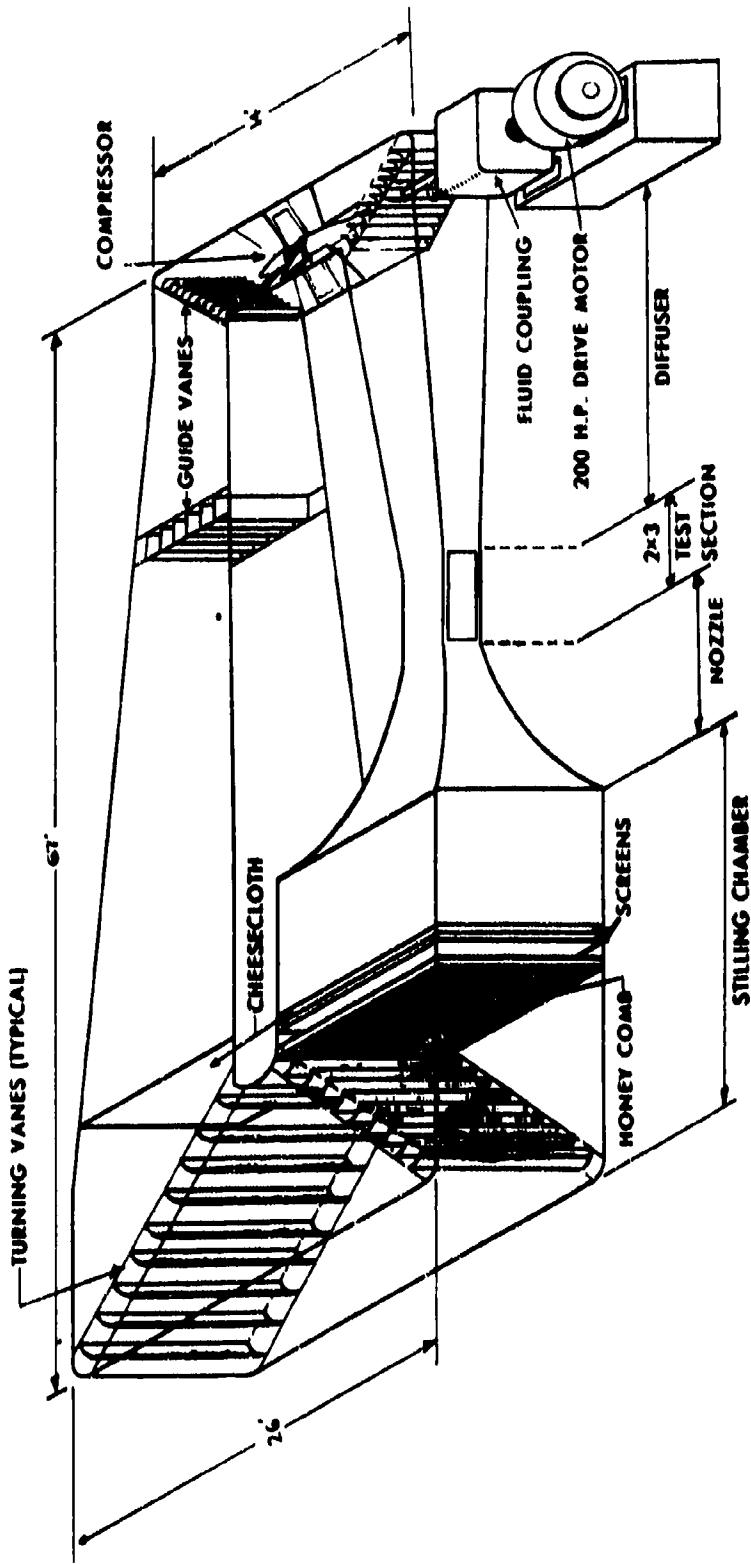


Figure 1. Wind Tunnel Schematic

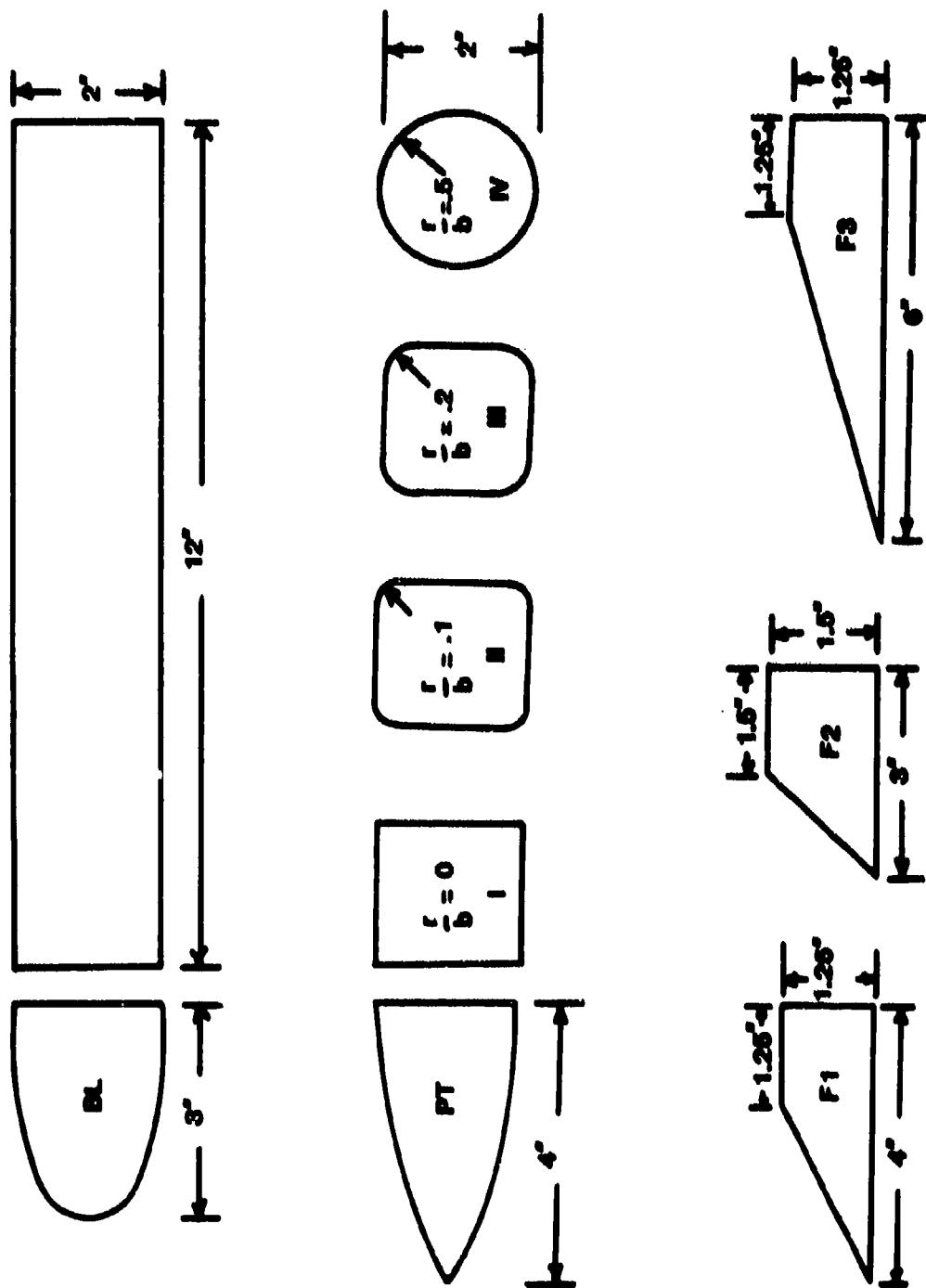


Figure 2. Components of Missile with Fineness Ratio 7.5

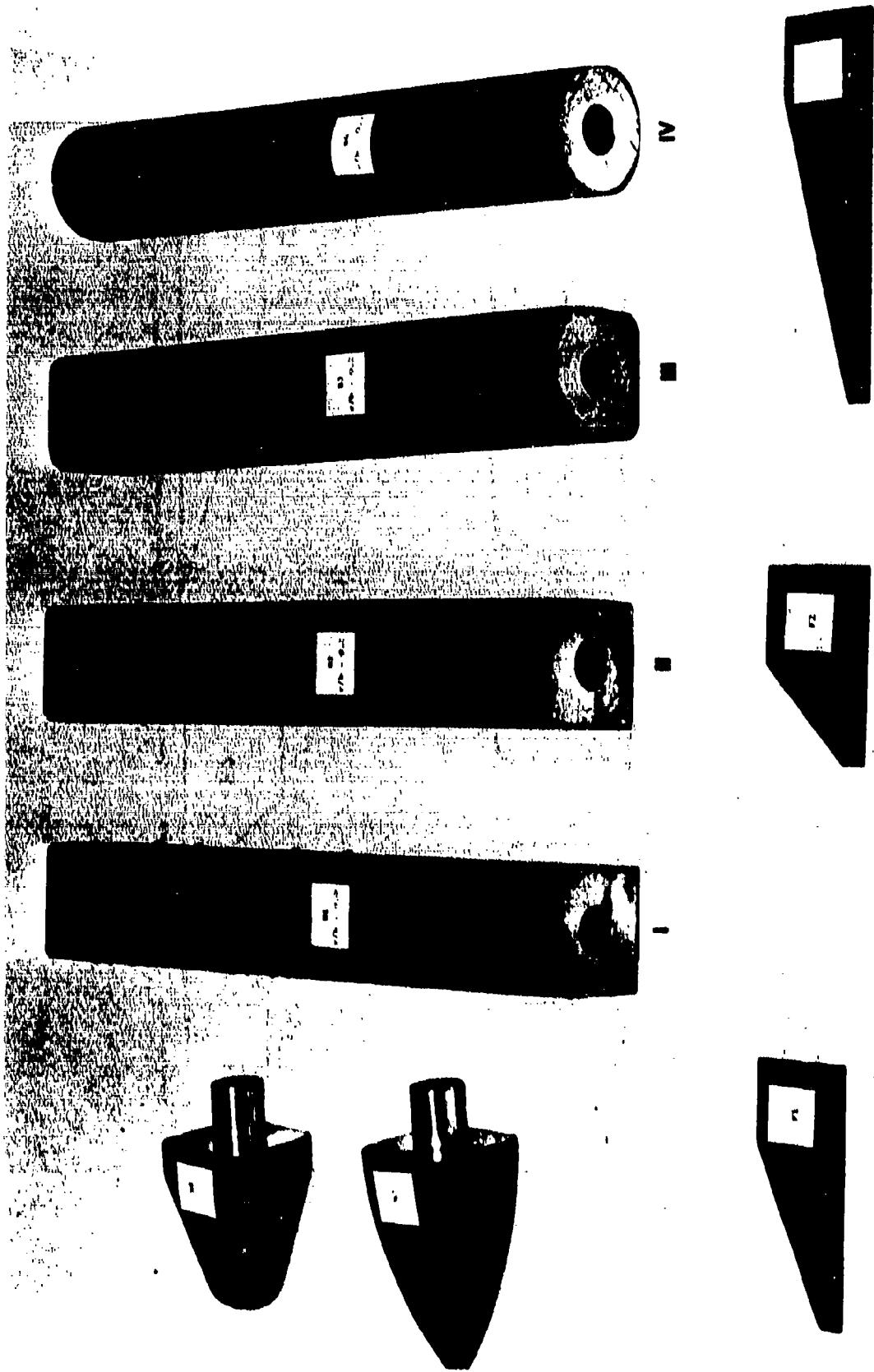


Figure 3. Model Components

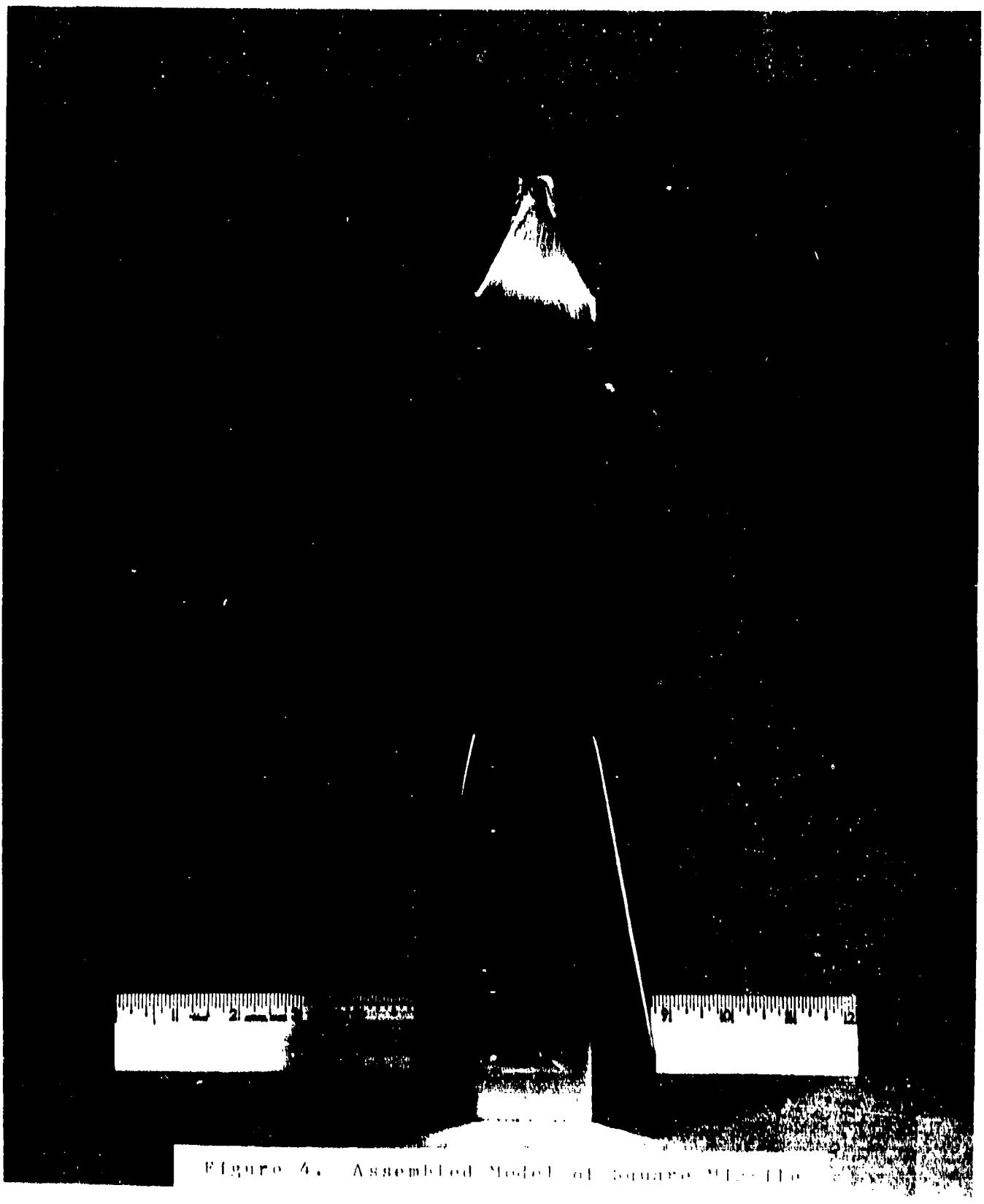


Figure 4. Assembled Model of Square Pyramid.

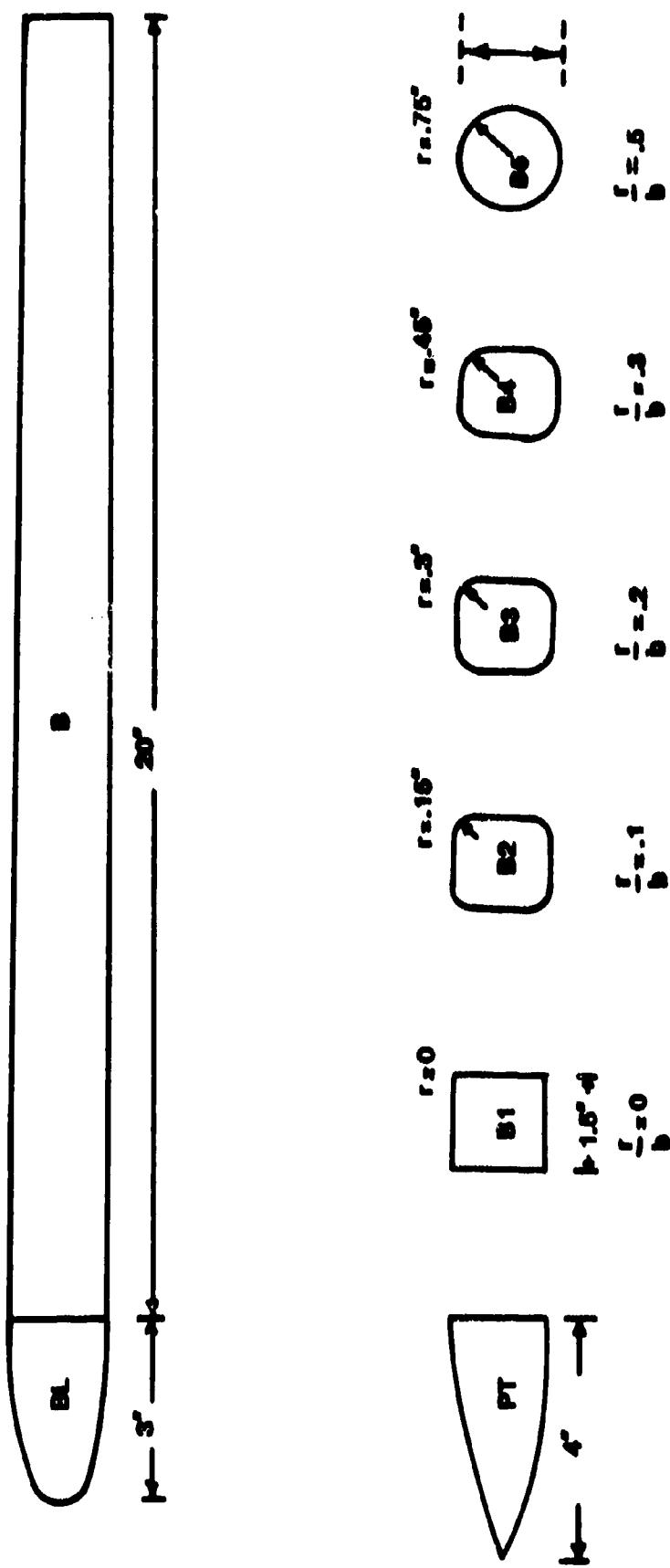


Figure 5. Missile of Fineness Ratio 16 Components

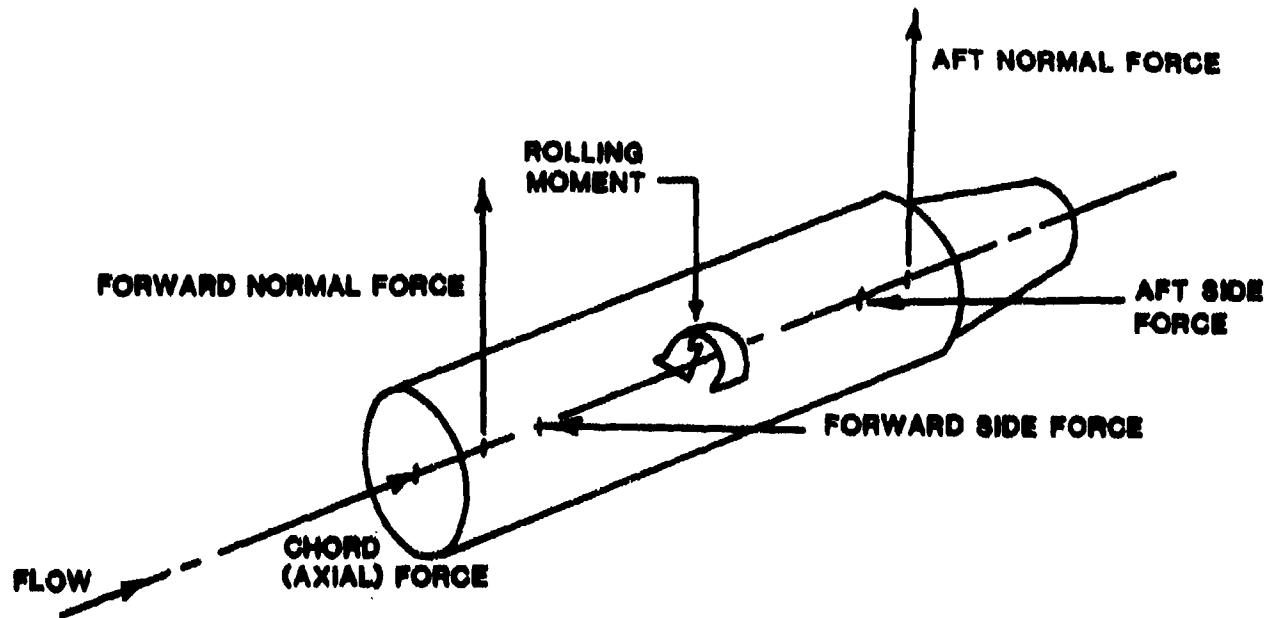


Figure 6a. Balance Loads

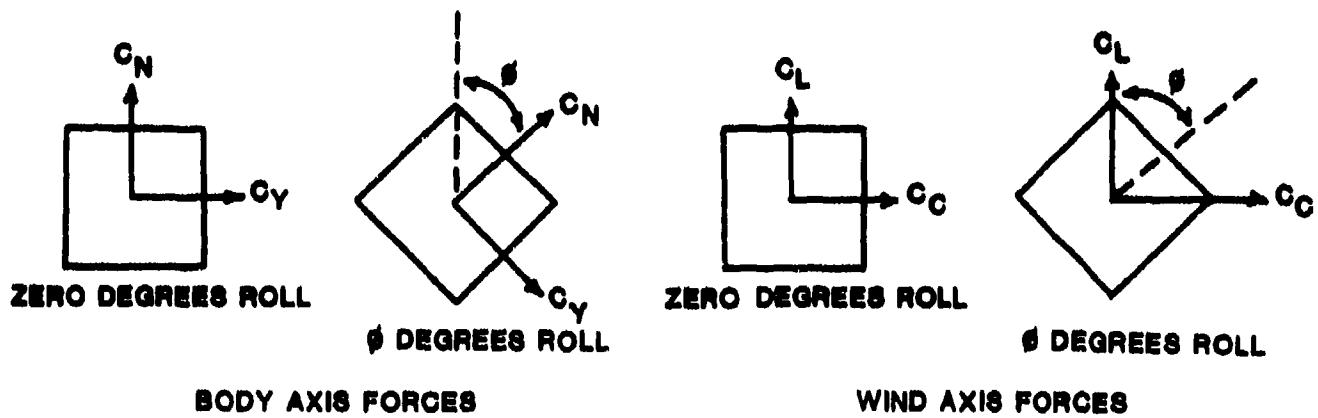


Figure 6b. Body and Wind Axis Systems (Looking at Aft Side of the Model). Direction of Airflow Is Out of Plane of Paper

Figure 6. Direction of Positive Forces

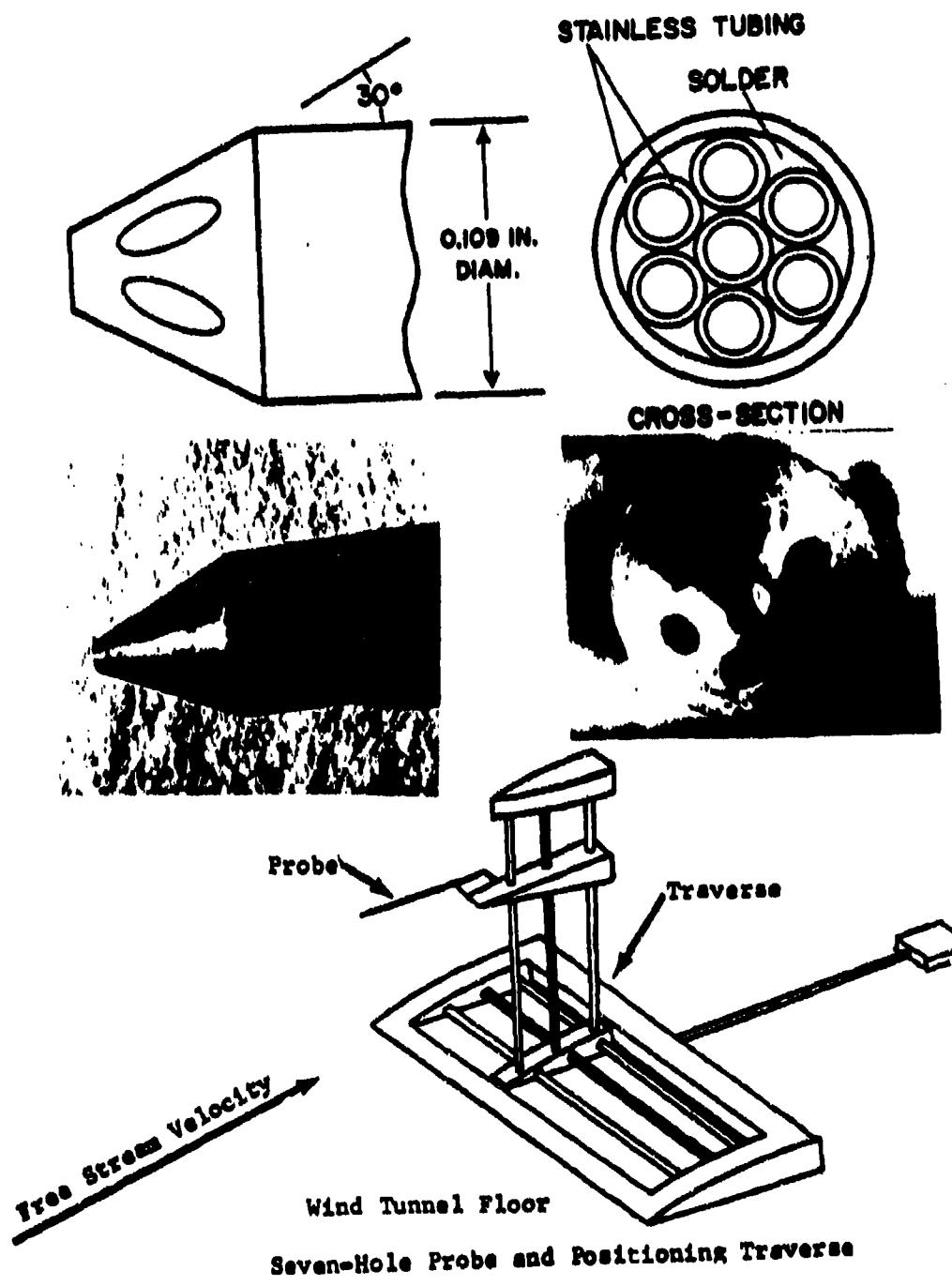


Figure 7. Seven-Hole Probe and Positioning System

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Appendix A

FORCE AND MOMENT COMPARISONS OF VARIOUS MISSILE CONFIGURATIONS

Force and moment tests were conducted only on the missiles of fineness ratio equal to 8. Each model configuration was mounted on the sting at the pitch center of the pitch rotation system which placed the force and moment balance center at the tunnel test section centerline. Six components of force and moment data were taken in two degree increments from 0 to 30 degrees pitch angle at roll orientations of 0, 11.25, 22.5, 33.75, and 45 degrees. The angle between the longitudinal axis of the sting and the freestream velocity was defined as the pitch angle and for a 0 degree roll orientation the pitch angle and angle of attack were the same. At the other roll orientations the pitch angle equated to a combination of angle of attack and sideslip. The freestream velocity was approximately 360 fps ($M = .31$) and the Reynolds number was approximately 2.5×10^5 for all tests. Forces and moments were recorded in either the body or wind axes systems. All results were non-dimensionalized using the cross-sectional area (0.0218 square feet) of the circular body (IV) and a length of the body cross-section width (2 inches for bodies I-IV).

Force and Moment coefficients are graphically plotted in Figures A-01 through A-30. Figures A-01 through A-18 show body axis data

while Figures A-19 through A-30 show wind axis data. All coefficients are plotted versus pitch angle from zero to 30 degrees. Besides showing the effects of pitch angle variation, the graphs also illustrate the effects of changes in body corner radius, nose variation and fin variation. Also shown above each graph is a data scheme that illustrates the missile configuration tested. Each configuration was labeled according to the component nomenclature shown in Figure 2. For instance, the square body tested at 22.5 roll and with the 4-inch length fin and blunt nose configuration is noted as I/22.5/F1/BL. Table A-1 illustrates the nomenclature for the force and moment coefficients. Table A-2 summarizes the 30 figures in the appendix.

TABLE A-1
FORCE/MOMENT COEFFICIENTS

<u>Wind Axis</u>	<u>Body Axis</u>
CL - Lift Coefficient	CN - Normal Force Coefficient
CD - Drag Coefficient	CA - Axial Force Coefficient
CC - Cross-Force Coefficient	CY - Side-Force Coefficient
CMW - Pitching Moment Coefficient	CM - Pitching Moment Coefficient
CLW - Rolling Moment Coefficient	ROLCO - Rolling Moment Coefficient
CNW - Yawing Moment Coefficient	YMC0 - Yawing Moment Coefficient

TABLE A-2
SUMMARY OF FORCE AND MOMENT GRAPHS
BODY AXIS SYSTEM DATA

<u>Appendix Figure</u>	<u>Missile Configuration</u>	<u>Parameter Varied</u>
A-1	0° Roll, No Fins, Blunt Nose	Corner Radius (Bodies I-IV)
A-2	22° Roll, No Fins, Blunt Nose	Corner Radius (Bodies I-IV)
A-3	45° Roll, No Fins, Blunt Nose	Corner Radius (Bodies I-IV)
A-4	0° Roll, Fin 1, Blunt Nose	Corner Radius (Bodies I-IV)
A-5	22° Roll, Fin 1, Blunt Nose	Corner Radius (Bodies I-IV)
A-6	45° Roll, Fin 1, Blunt Nose	Corner Radius (Bodies I-IV)
A-7	Missile III, 0° Roll, No Fins/Fin 1	Noses (BL & PT Noses)
A-8	Missile III, 22° Roll, No Fins/Fin 1	Noses (BL & PT Noses)
A-9	Missile III, 45° Roll, No Fins/Fin 1	Noses (BL & PT Noses)
A-10	Missile III, 0° Roll, F1 & F3	Noses (BL & PT Noses)
A-11	Missile III, 22° Roll, F1 & F3	Noses (BL & PT Noses)
A-12	Missile III, 45° Roll, F1 & F3	Noses (BL & PT Noses)
A-13	Missile III, 0° Roll, Blunt Nose	Fins (NF, F1, F2, F3)
A-14	Missile III, 22° Roll, Blunt Nose	Fins (NF, F1, F2, F3)
A-15	Missile III, 45° Roll, Blunt Nose	Fins (NF, F1, F2, F3)
A-16	Missile III, 0° Roll, Pointed Nose	Fins (NF, F1, F2, F3)
A-17	Missile III, 22° Roll, Pointed Nose	Fins (NF, F1, F2, F3)
A-18	Missile III, 45° Roll, Pointed Nose	Fins (NF, F1, F2, F3)

Table A- 2 Summary of Force and Moment Graphs (cont'd)

<u>WIND AXIS SYSTEM DATA</u>		
<u>Appendix Figure</u>	<u>Missile Configuration</u>	<u>Parameter Varied</u>
A-19	11° Roll, No Fins, Blunt Nose	Corner Radius (Bodies I-IV)
A-20	33° Roll, No Fins, Blunt Nose	Corner Radius (Bodies I-IV)
A-21	11° Roll, Fin 1, Blunt Nose	Corner Radius (Bodies I-IV)
A-22	33° Roll, Fin 1, Blunt Nose	Corner Radius (Bodies I-IV)
A-23	Missile III, 11° Roll, No Fins/Fin 1	Noses (BL & PT Noses)
A-24	Missile III, 33° Roll, No Fins/Fin 1	Noses (BL & PT Noses)
A-25	Missile III, 11° Roll, F1 & F3	Noses (BL & PT Noses)
A-26	Missile III, 33° Roll, F1 & F3	Noses (BL & PT Noses)
A-27	Missile III, 11° Roll, Blunt Nose	Fins (NF, F1, F2, F3)
A-28	Missile III, 33° Roll, Blunt Nose	Fins (NF, F1, F2, F3)
A-29	Missile III, 11° Roll, Pointed Nose	Fins (NF, F1, F2, F3)
A-30	Missile III, 33° Roll, Pointed Nose	Fins (NF, F1, F2, F3)

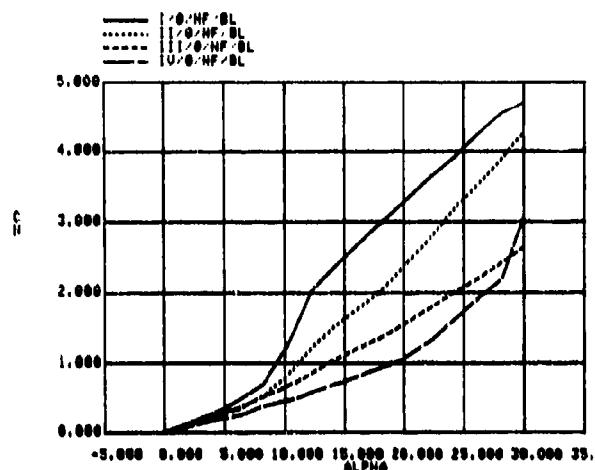


FIGURE A-1.1 BODY CORNER RADIUS EFFECTS

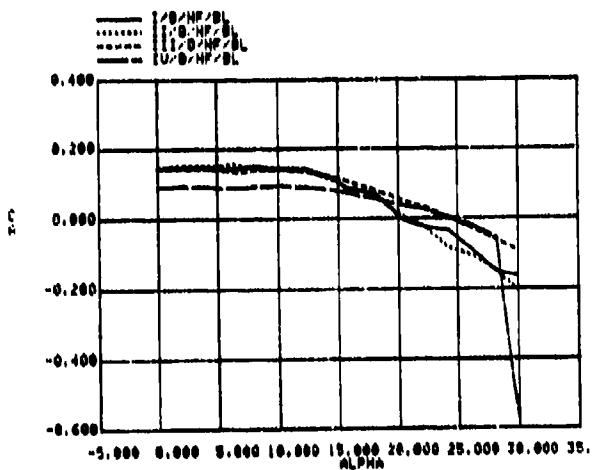


FIGURE A-1.2 BODY CORNER RADIUS EFFECTS

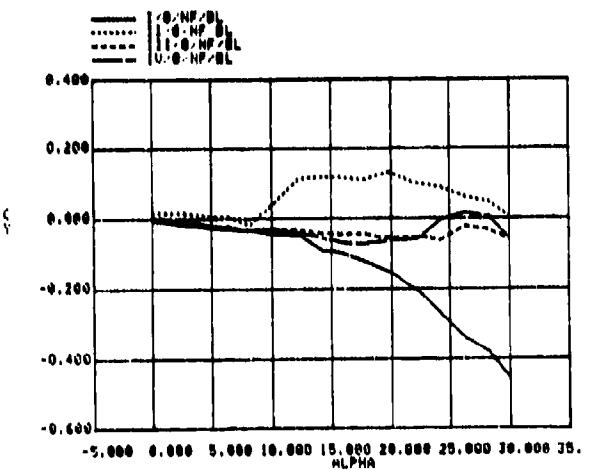


FIGURE A-1.3 BODY CORNER RADIUS EFFECTS

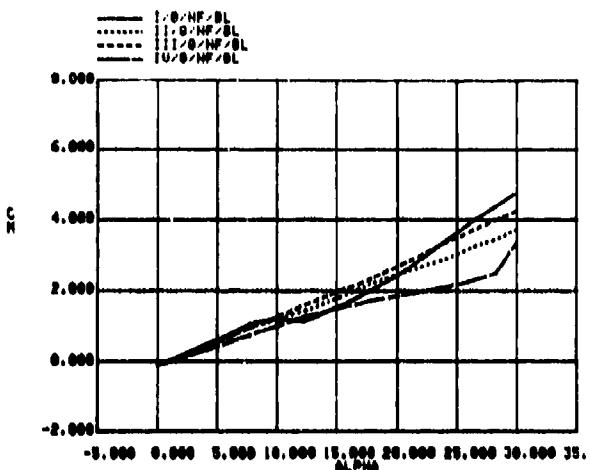


FIGURE A-1.4 BODY CORNER RADIUS EFFECTS

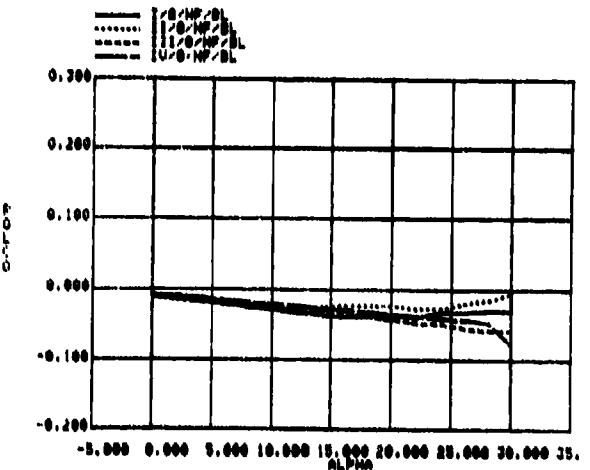


FIGURE A-1.5 BODY CORNER RADIUS EFFECTS

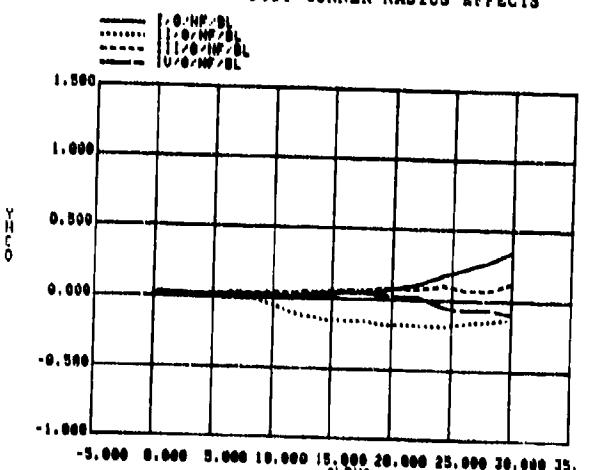


FIGURE A-1.6 BODY CORNER RADIUS EFFECTS

FIGURE A-1. BODY AXIS FORCE & MOMENT BODY EFFECTS, 0 ROLL ANGLE,
NO FINS, BLUNT NOSE.

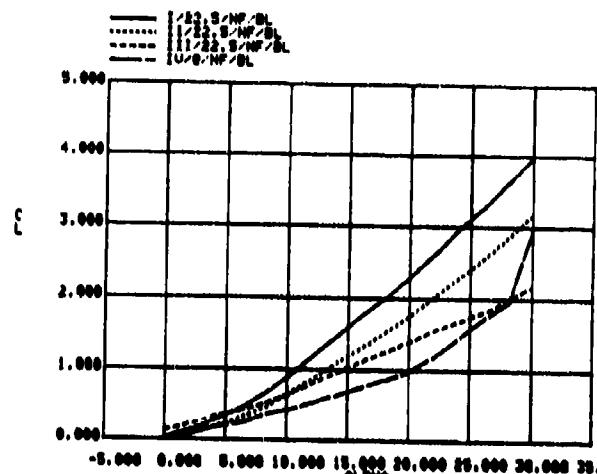


FIGURE A-2.1 BODY CORNER RADIUS EFFECTS

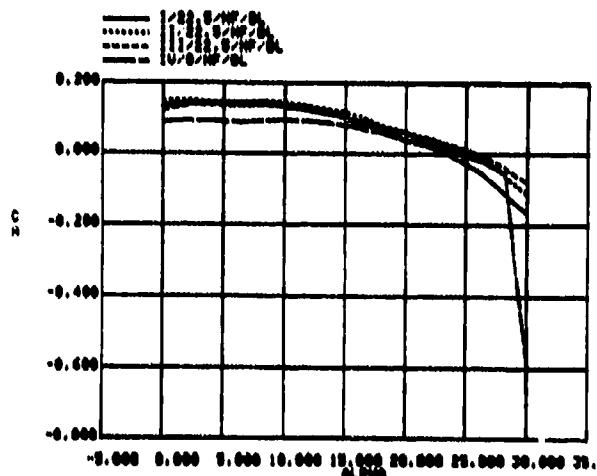


FIGURE A-2.2 BODY CORNER RADIUS EFFECTS

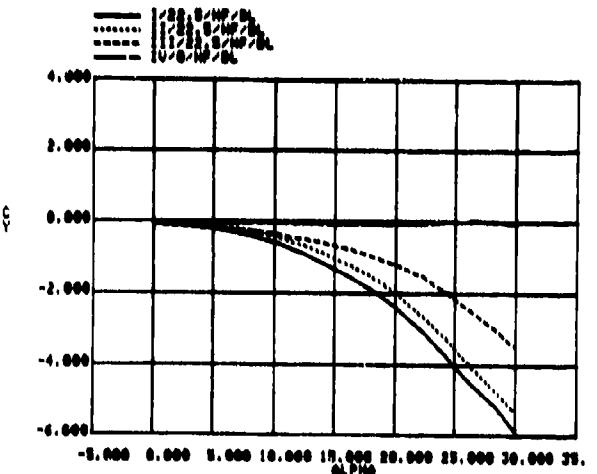


FIGURE A-2.3 BODY CORNER RADIUS EFFECTS

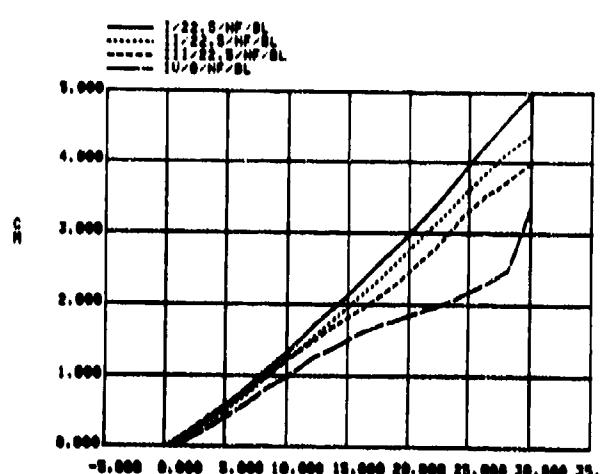


FIGURE A-2.4 BODY CORNER RADIUS EFFECTS

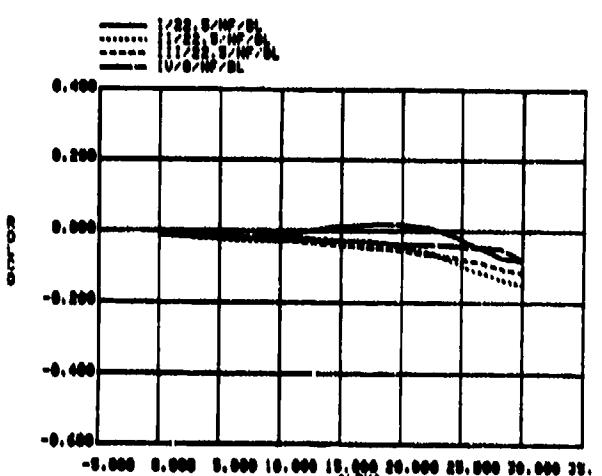


FIGURE A-2.5 BODY CORNER RADIUS EFFECTS

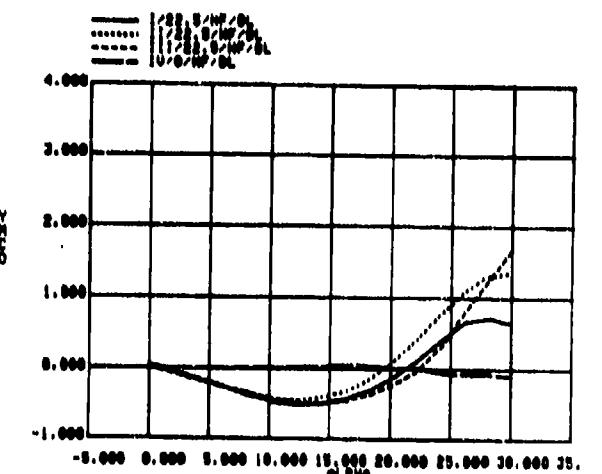


FIGURE A-2.6 BODY CORNER RADIUS EFFECTS

FIGURE A-2. BODY AXIS FORCE & MOMENT BODY EFFECTS, 22 ROLL ANGLE,
NO FINS, BLUNT NOSE.

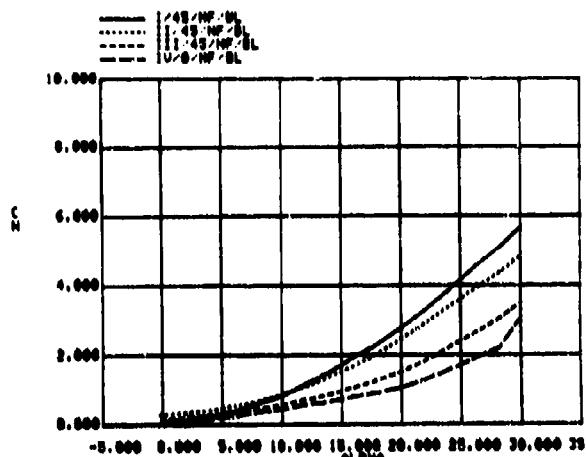


FIGURE A-3.1 BODY CORNER RADIUS EFFECTS

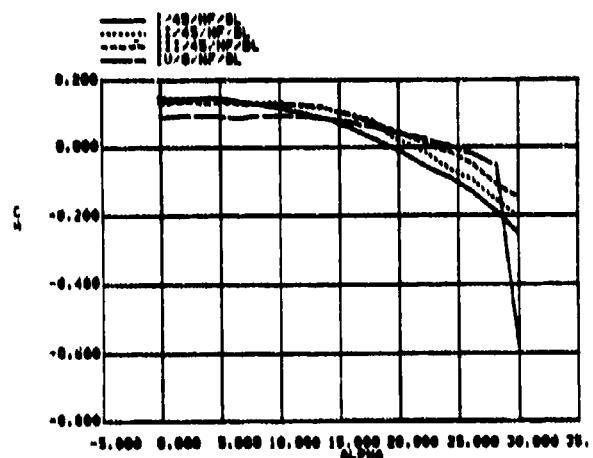


FIGURE A-3.2 BODY CORNER RADIUS EFFECTS

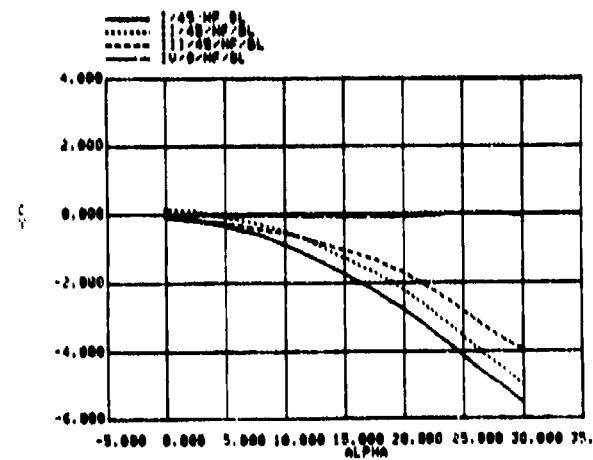


FIGURE A-3.3 BODY CORNER RADIUS EFFECTS

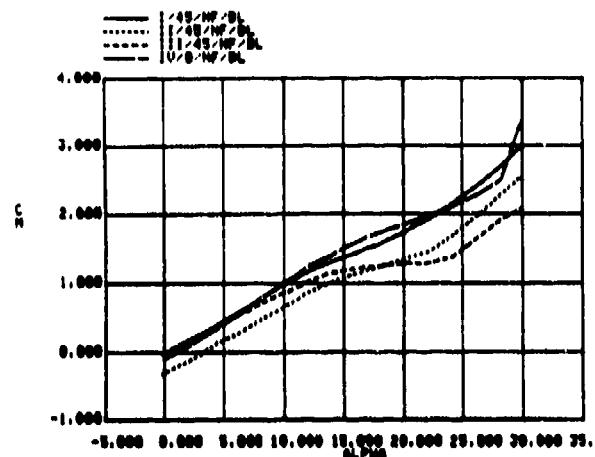


FIGURE A-3.4 BODY CORNER RADIUS EFFECTS

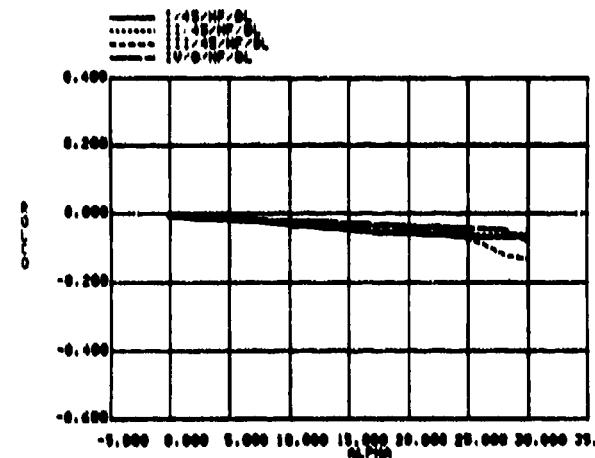


FIGURE A-3.5 BODY CORNER RADIUS EFFECTS

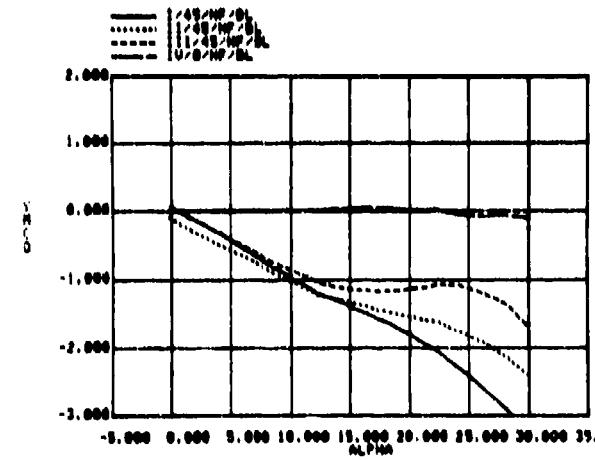


FIGURE A-3.6 BODY CORNER RADIUS EFFECTS

FIGURE A-3. BODY AXIS FORCE & MOMENT BODY EFFECTS, 45 ROLL ANGLE.

NO FINS, BLUNT NOSE.

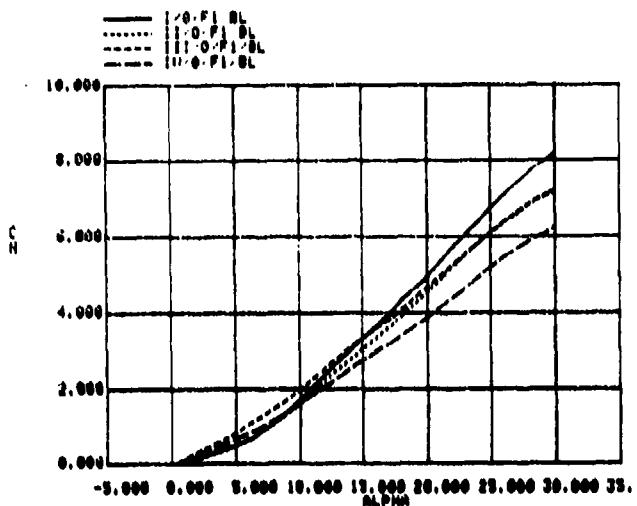


FIGURE A-4.1 BODY CORNER RADIUS EFFECTS

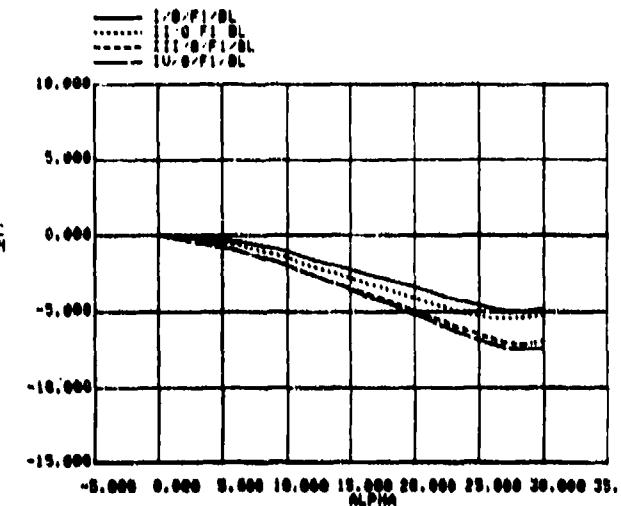


FIGURE A-4.4 BODY CORNER RADIUS EFFECTS

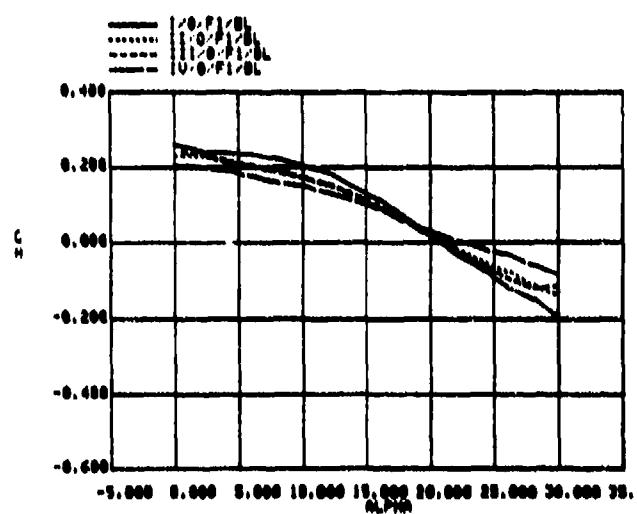


FIGURE A-4.2 BODY CORNER RADIUS EFFECTS

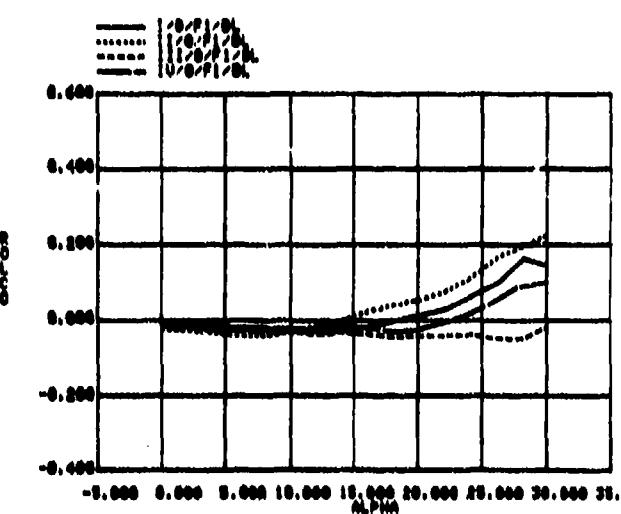


FIGURE A-4.5 BODY CORNER RADIUS EFFECTS

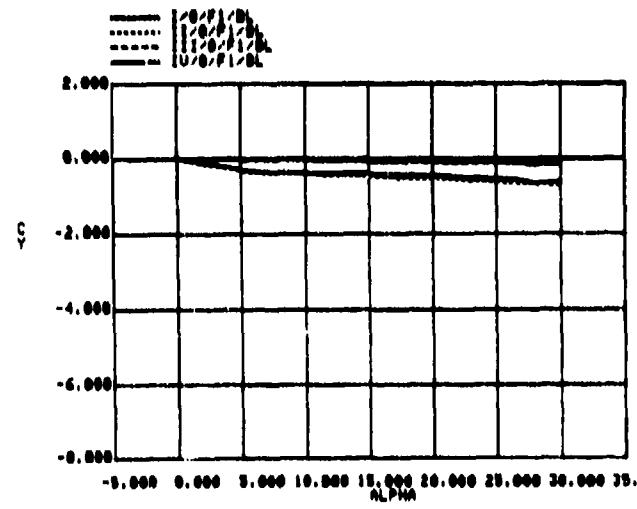


FIGURE A-4.3 BODY CORNER RADIUS EFFECTS

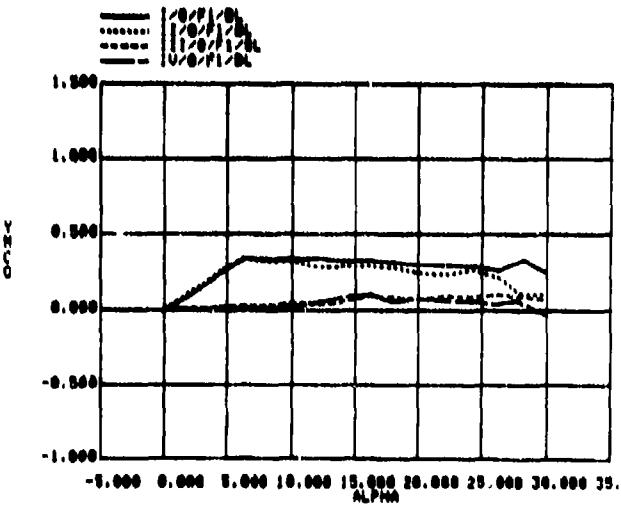


FIGURE A-4.6 BODY CORNER RADIUS EFFECTS

FIGURE A-4. BODY AXIS FORCE & MOMENT BODY EFFECTS, 0 ROLL ANGLE.

FIN 1, BLUNT NOSE.

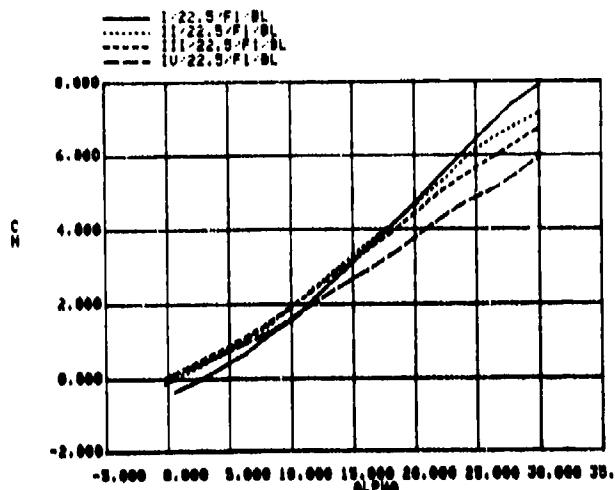


FIGURE A-5.1 BODY CORNER RADIUS EFFECTS

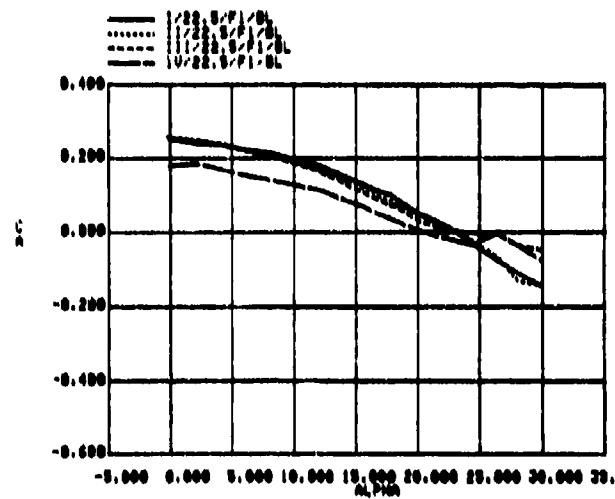


FIGURE A-5.2 BODY CORNER RADIUS EFFECTS

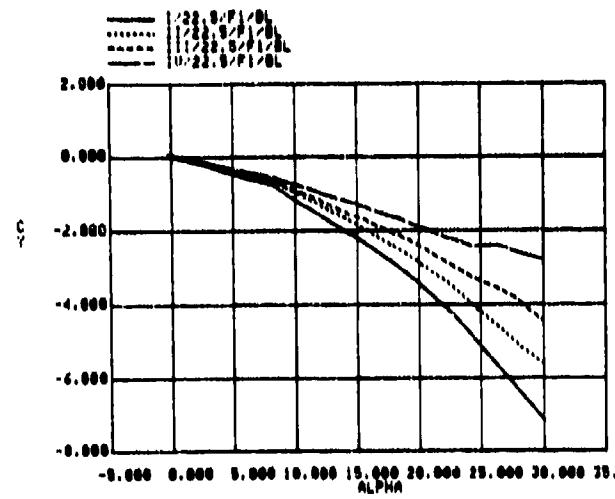


FIGURE A-5.3 BODY CORNER RADIUS EFFECTS

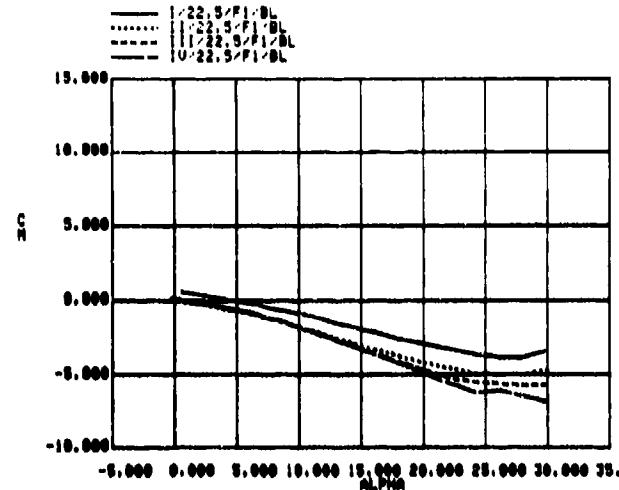


FIGURE A-5.4 BODY CORNER RADIUS EFFECTS

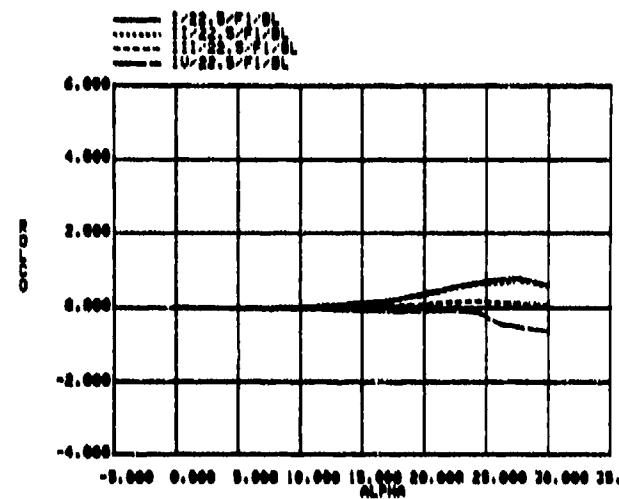


FIGURE A-5.5 BODY CORNER RADIUS EFFECTS

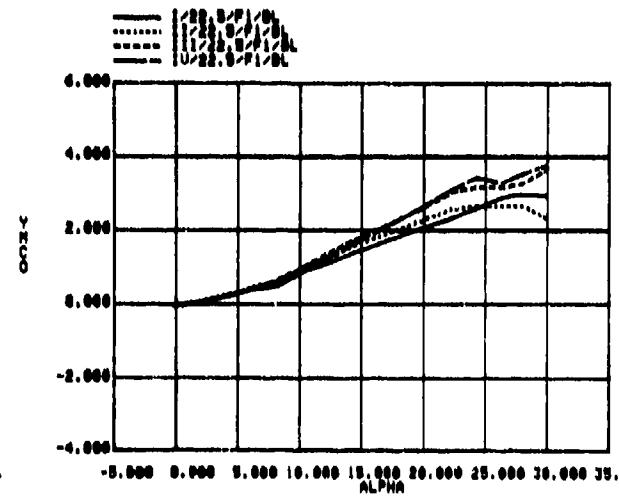


FIGURE A-5.6 BODY CORNER RADIUS EFFECTS

FIGURE A-5. BODY AXIS FORCE & MOMENT BODY EFFECTS, 22 ROLL ANGLE,
FIN 1, BLUNT NOSE.

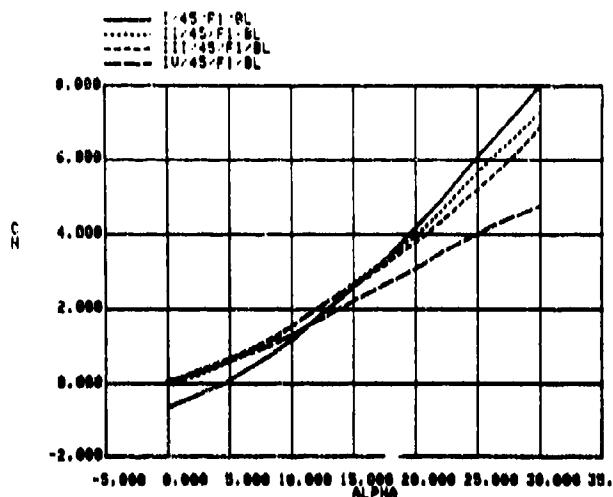


FIGURE A-6.1 BODY CORNER RADIUS EFFECTS

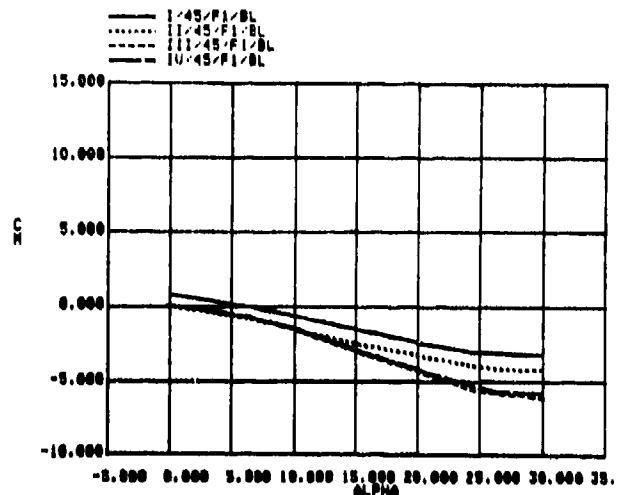


FIGURE A-6.4 BODY CORNER RADIUS EFFECTS

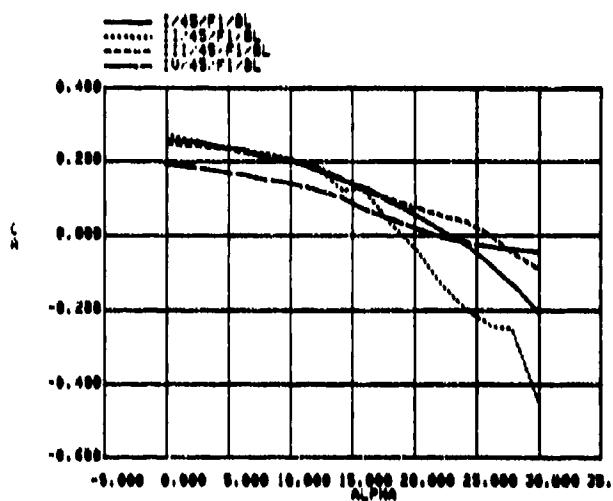


FIGURE A-6.2 BODY CORNER RADIUS EFFECTS

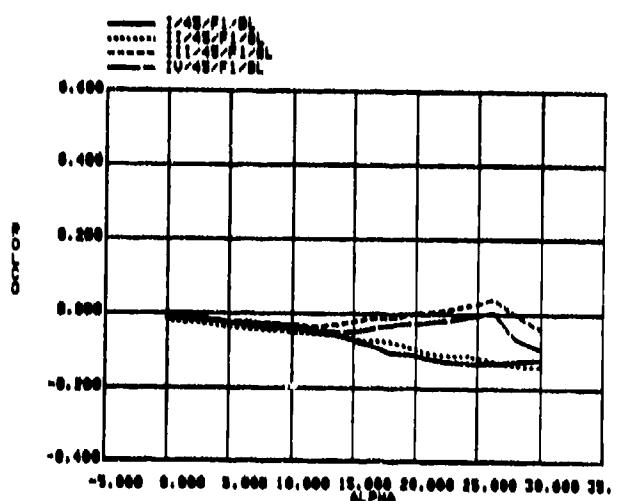


FIGURE A-6.5 BODY CORNER RADIUS EFFECTS

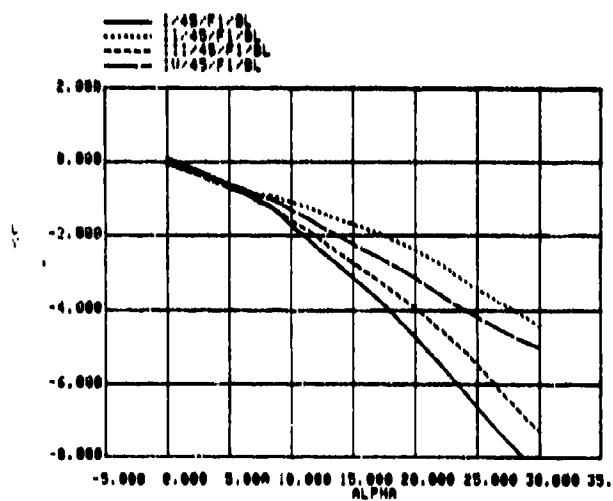


FIGURE A-6.3 BODY CORNER RADIUS EFFECTS

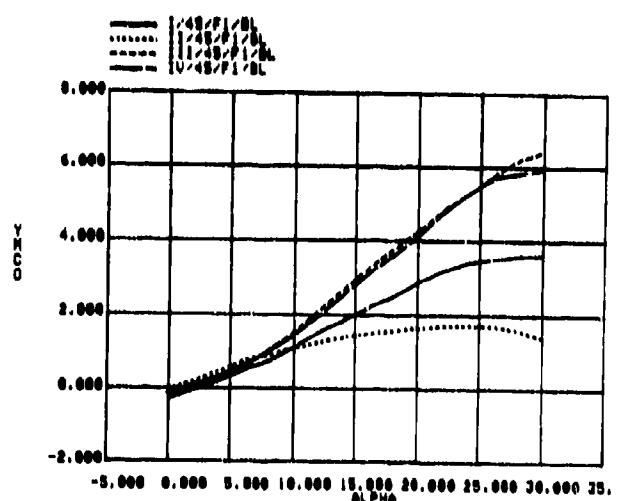


FIGURE A-6.6 BODY CORNER RADIUS EFFECTS

FIGURE A-6. BODY AXIS FORCE & MOMENT BODY EFFECTS, 45° ROLL ANGLE.

FIN 1, BLUNT NOSE.

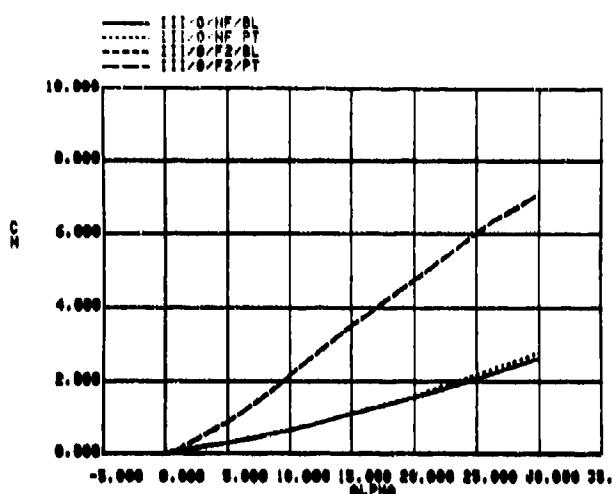


FIGURE A-7.1 NOSE EFFECTS

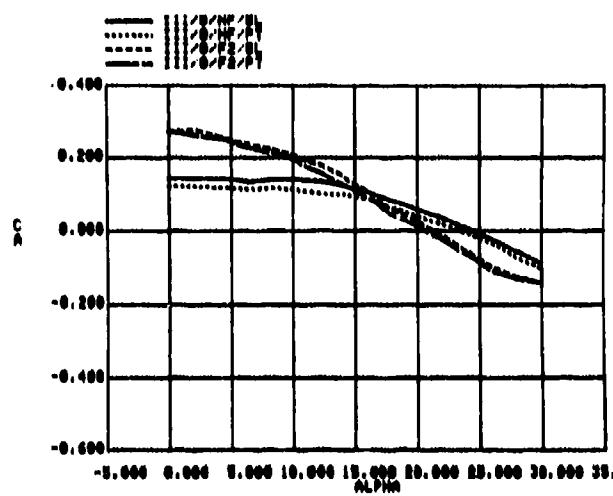


FIGURE A-7.2 NOSE EFFECTS

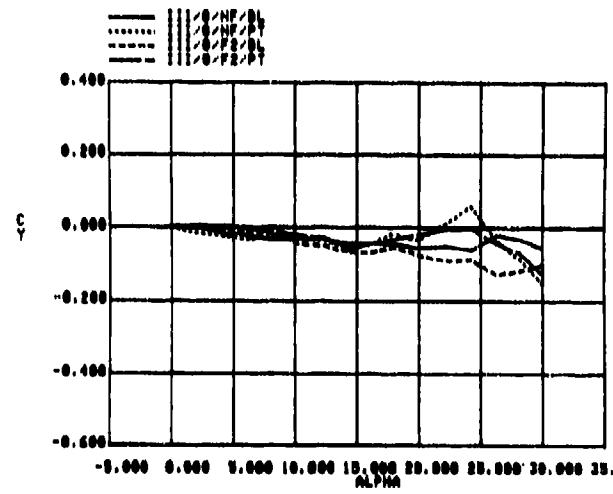


FIGURE A-7.3 NOSE EFFECTS

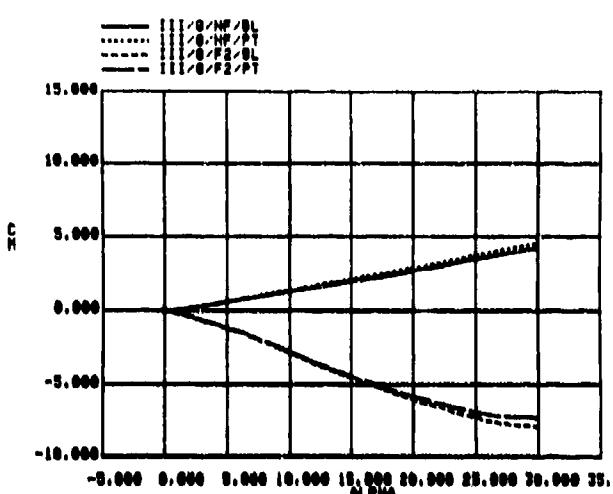


FIGURE A-7.4 NOSE EFFECTS

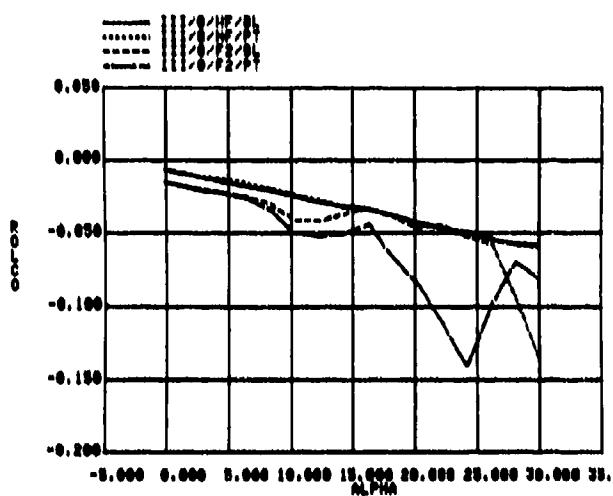


FIGURE A-7.5 NOSE EFFECTS

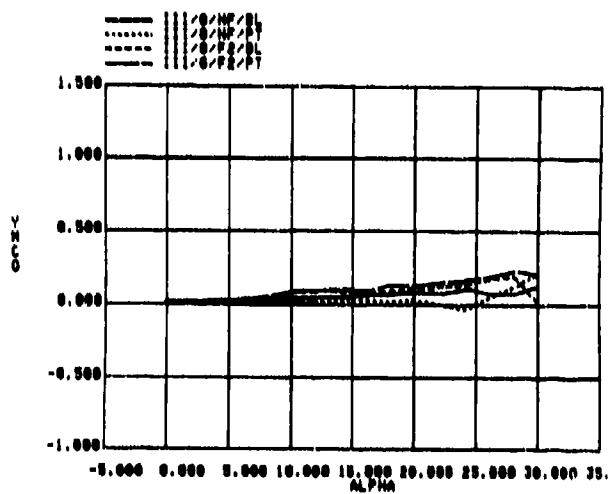


FIGURE A-7.6 NOSE EFFECTS

FIGURE A-7. BODY AXIS FORCE & MOMENT NOSE EFFECTS, MISSILE III.
ROLL 0, NO FIN/FIN 2, BLUNT/POINTED NOSE.

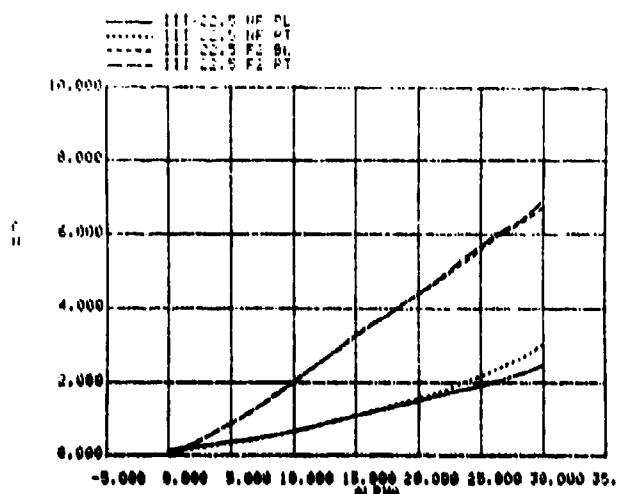


FIGURE A-8.1 NOSE EFFECTS

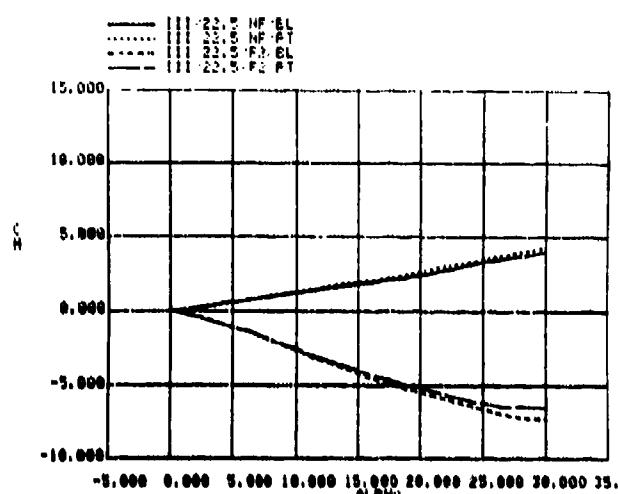


FIGURE A-8.4 NOSE EFFECTS

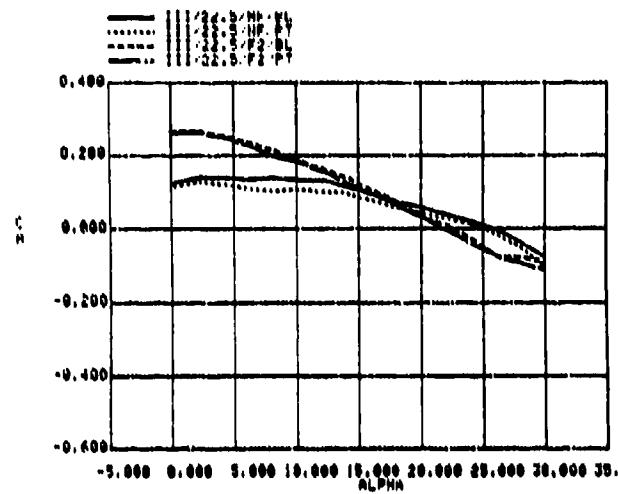


FIGURE A-8.2 NOSE EFFECTS

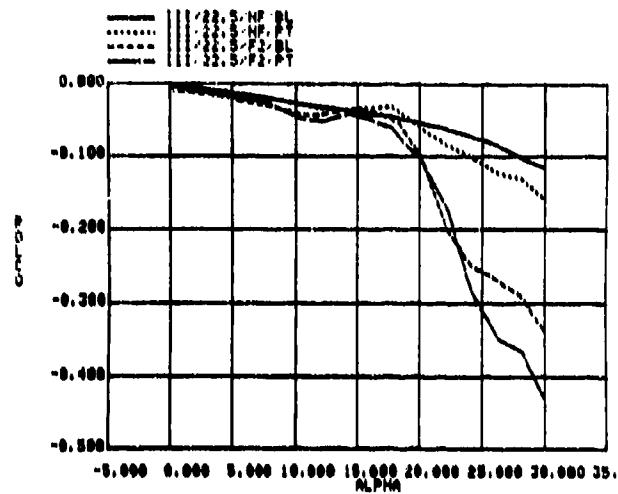


FIGURE A-8.5 NOSE EFFECTS

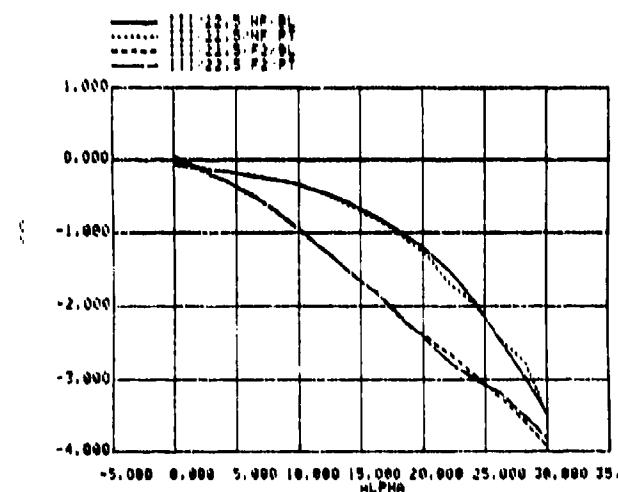


FIGURE A-8.3 NOSE EFFECTS

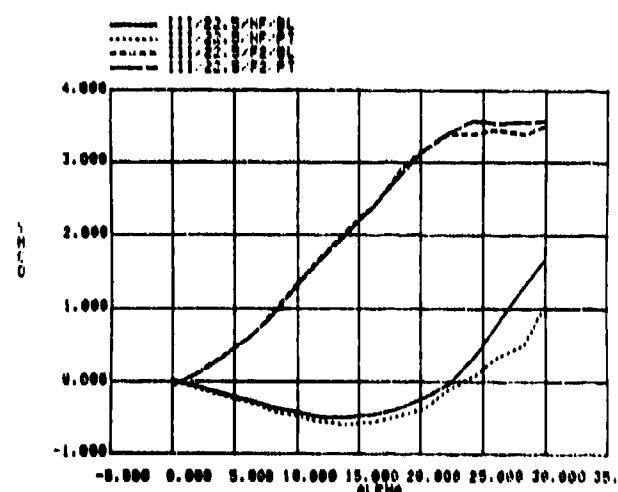


FIGURE A-8.6 NOSE EFFECTS

FIGURE A-8. BODY AXIS FORCE & MOMENT NOSE EFFECTS, MISSILE III.
ROLL 22, NO FIN/FIN 2, BLUNT/POINTED NOSE.

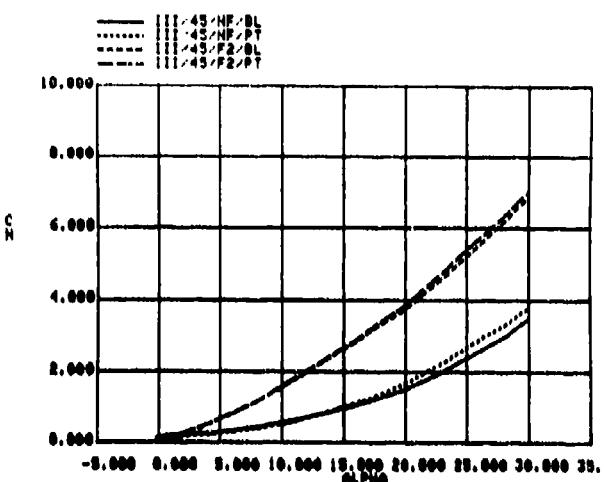


FIGURE A-9.1 NOSE EFFECTS

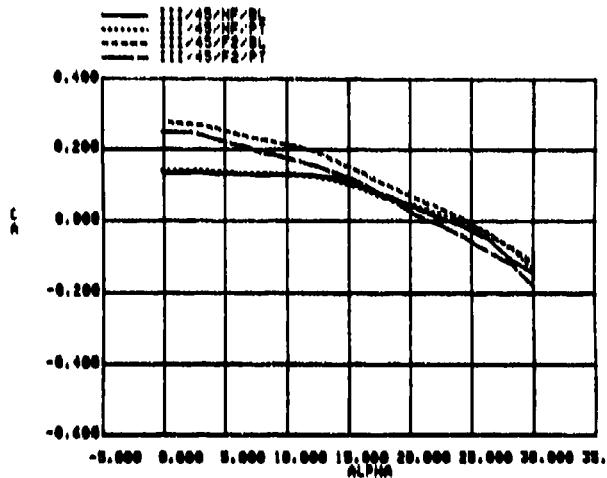


FIGURE A-9.2 NOSE EFFECTS

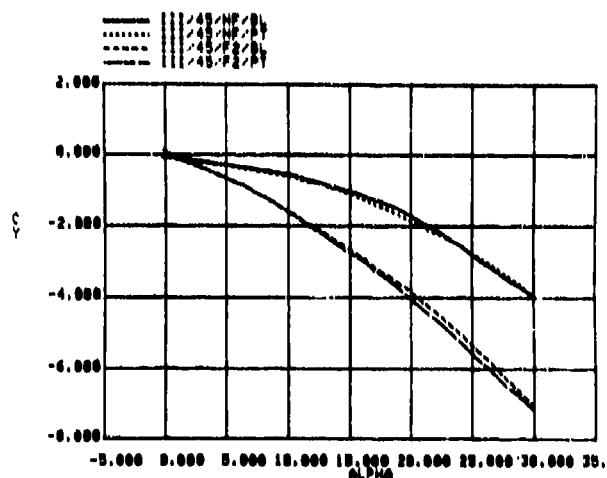


FIGURE A-9.3 NOSE EFFECTS

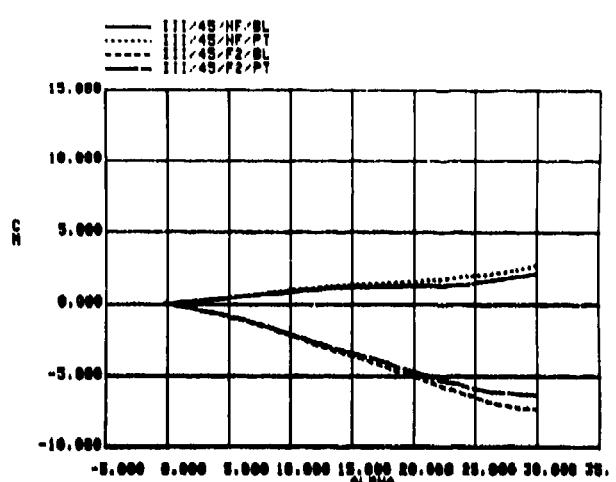


FIGURE A-9.4 NOSE EFFECTS

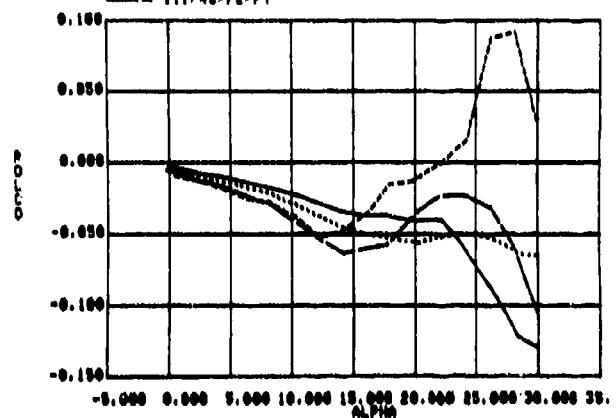


FIGURE A-9.5 NOSE EFFECTS

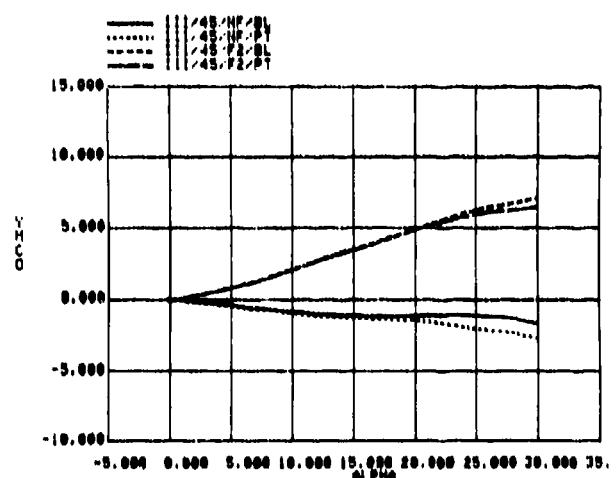


FIGURE A-9.6 NOSE EFFECTS

FIGURE A-9. BODY AXIS FORCE & MOMENT NOSE EFFECTS, MISSILE III.

ROLL 45, NO FIN/FIN 2, BLUNT/POINTED NOSE.

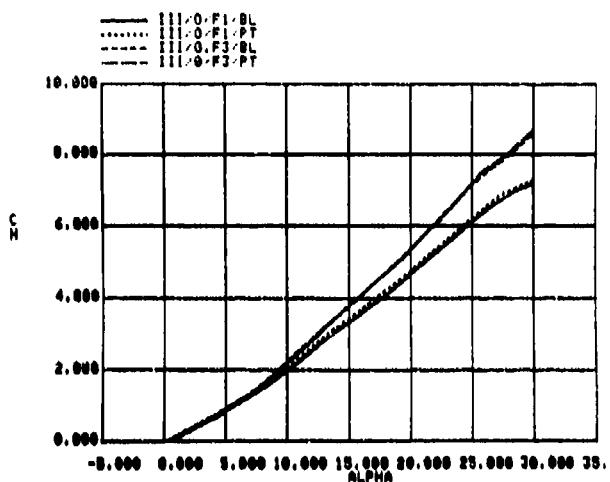


FIGURE A-10.1 NOSE EFFECTS

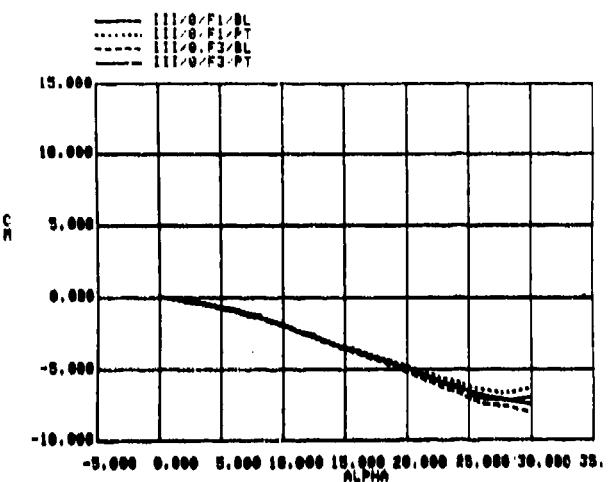


FIGURE A-10.4 NOSE EFFECTS

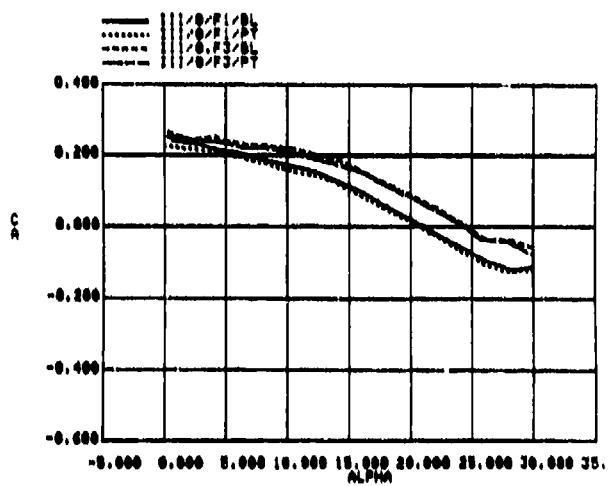


FIGURE A-10.2 NOSE EFFECTS

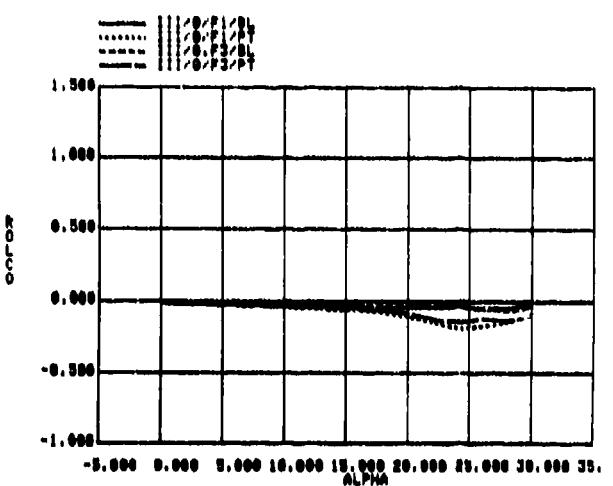


FIGURE A-10.5 NOSE EFFECTS

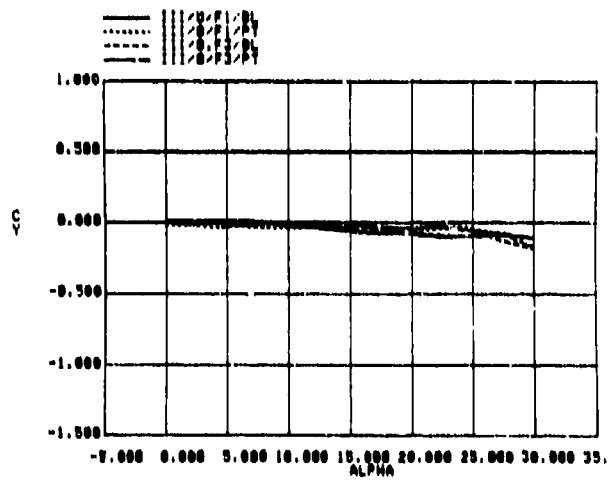


FIGURE A-10.3 NOSE EFFECTS

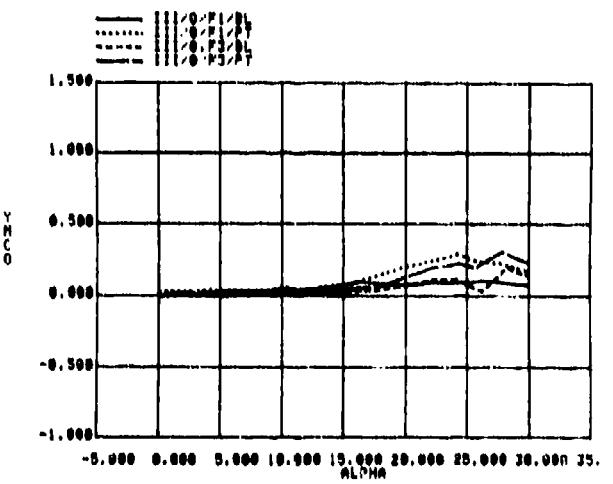


FIGURE A-10.6 NOSE EFFECTS

FIGURE A-10. BODY AXIS FORCE & MOMENT NOSE EFFECTS, MISSILE III.
ROLL 0, FIN 1/FIN 3, BLUNT/POINTED NOSE.

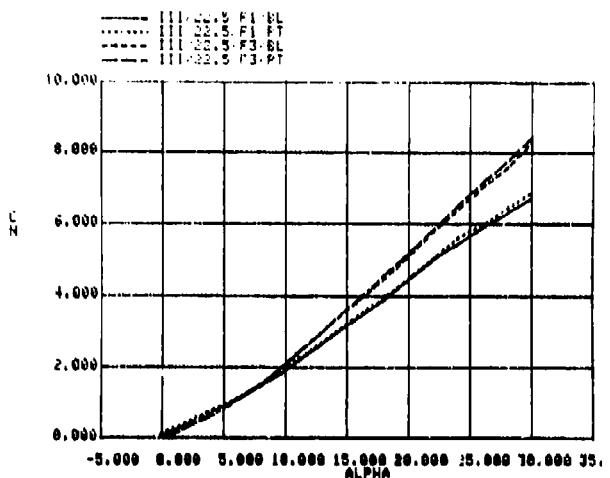


FIGURE A-11.1 NOSE EFFECTS

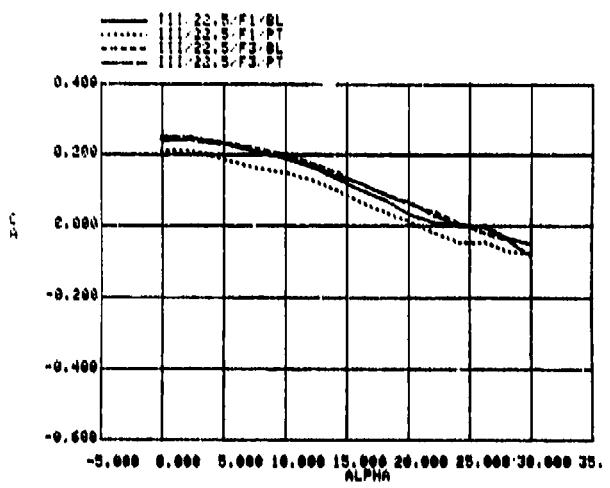


FIGURE A-11.2 NOSE EFFECTS

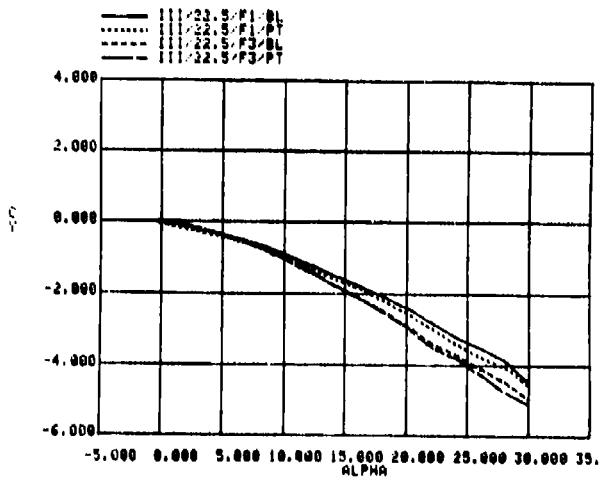


FIGURE A-11.3 NOSE EFFECTS

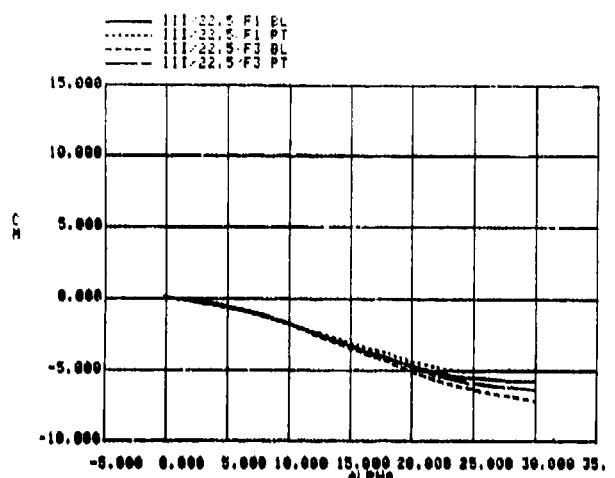


FIGURE A-11.4 NOSE EFFECTS

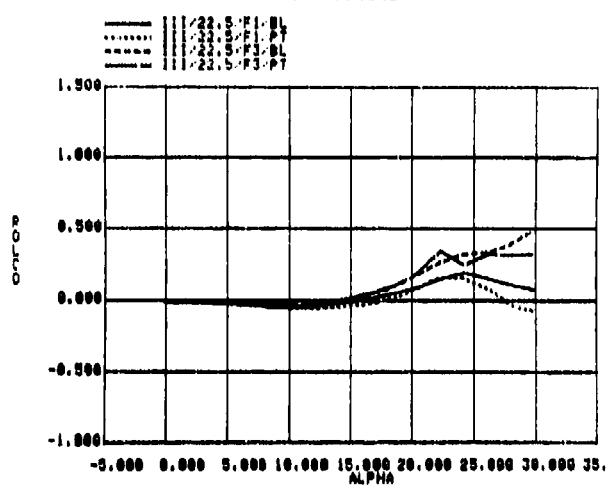


FIGURE A-11.5 NOSE EFFECTS

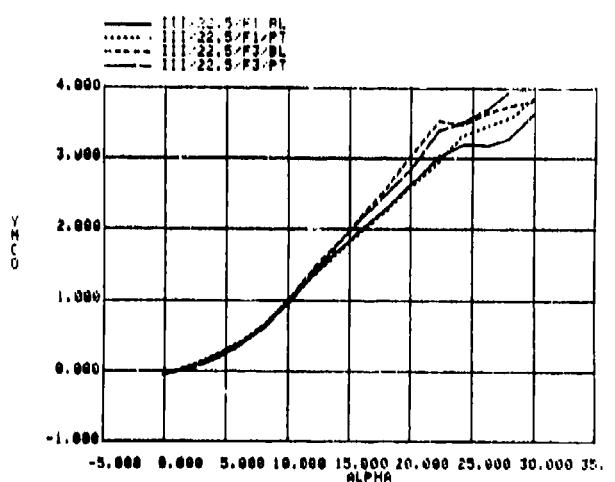


FIGURE A-11.6 NOSE EFFECTS

FIGURE A-11. BODY AXIS FORCE & MOMENT NOSE EFFECTS, MISSILE III,
ROLL 22, FIN 1/FIN 3, BLUNT/POINTED NOSE.

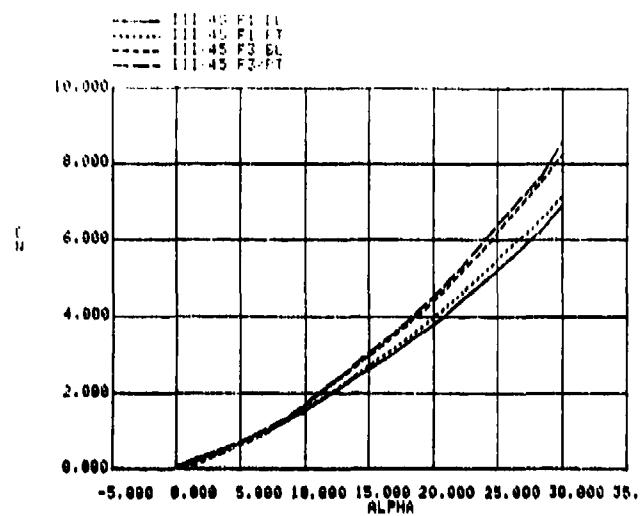


FIGURE A-12.1 NOSE EFFECTS

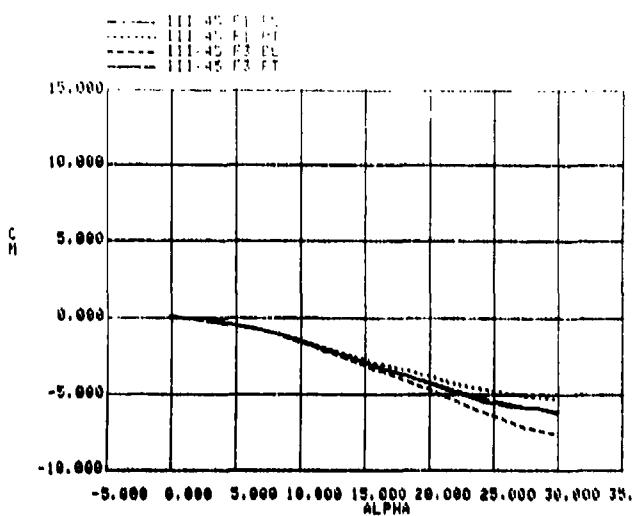


FIGURE A-12.4 NOSE EFFECTS

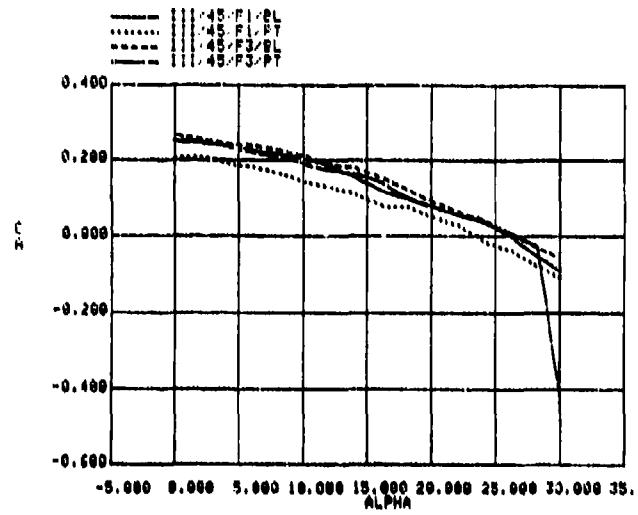


FIGURE A-12.2 NOSE EFFECTS

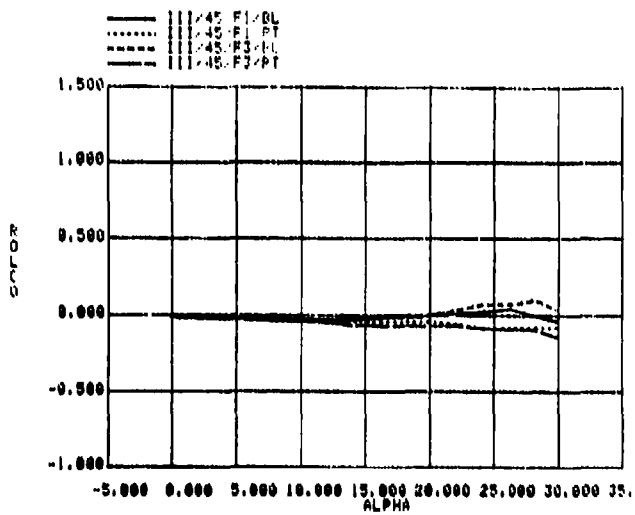


FIGURE A-12.5 NOSE EFFECTS

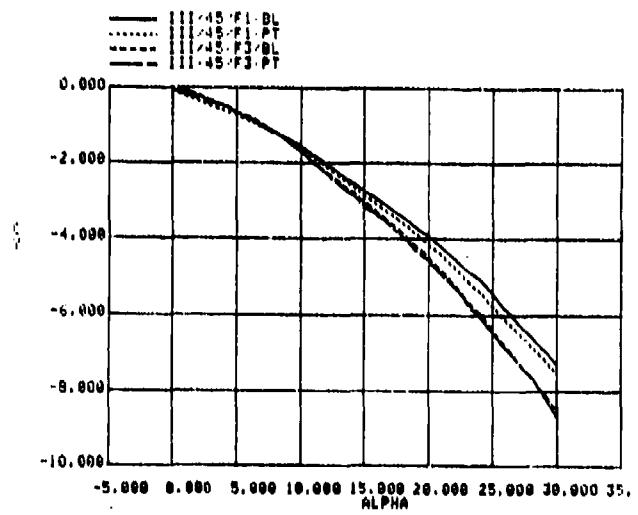


FIGURE A-12.3 NOSE EFFECTS

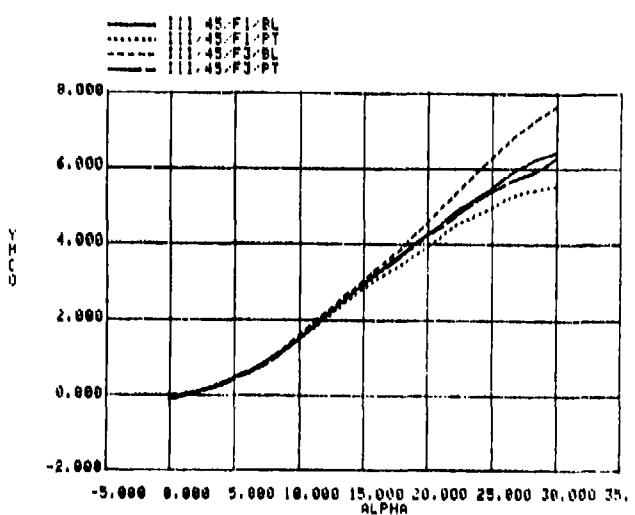


FIGURE A-12.6 NOSE EFFECTS

FIGURE A-12. BODY AXIS FORCE & MOMENT NOSE EFFECTS, MISSILE III.
ROLL 45, FIN 1/FIN 3, BLUNT/POINTED NOSE.

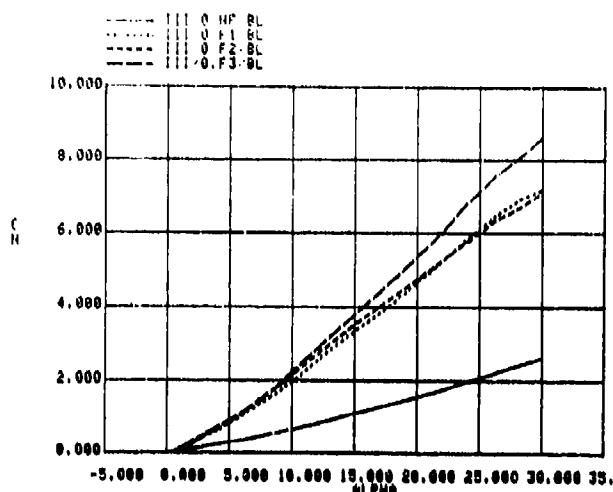


FIGURE A-13.1 FIN EFFECTS

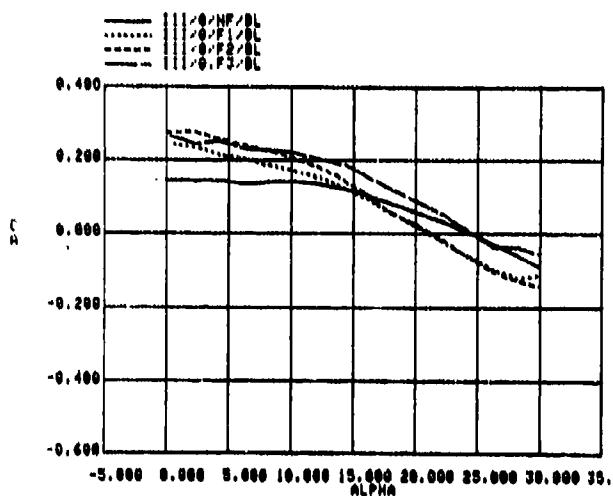


FIGURE A-13.2 FIN EFFECTS

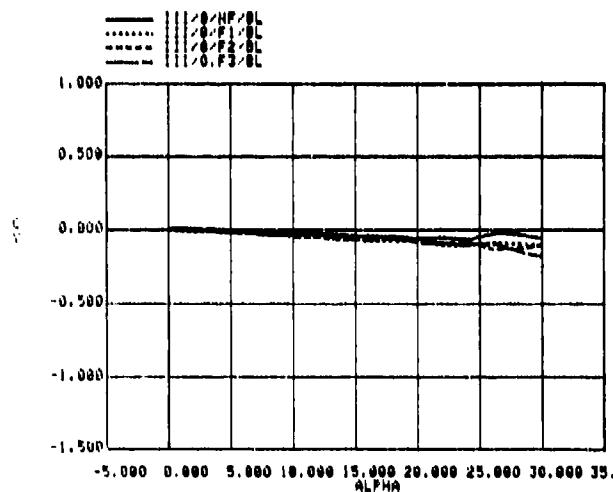


FIGURE A-13.3 FIN EFFECTS

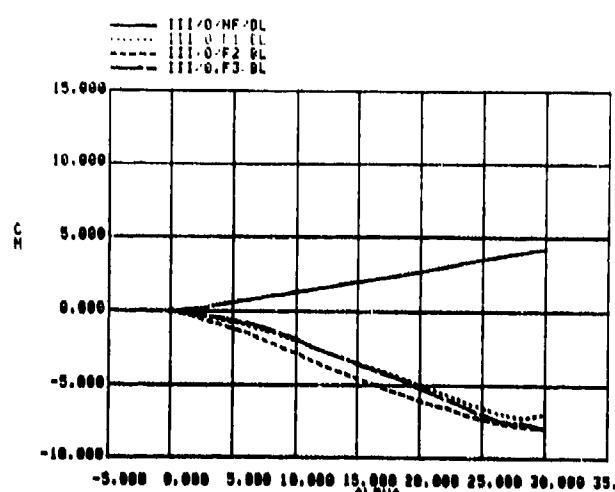


FIGURE A-13.4 FIN EFFECTS

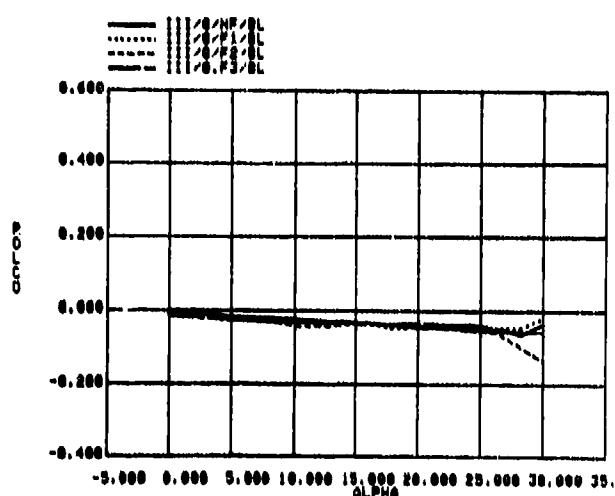


FIGURE A-13.5 FIN EFFECTS

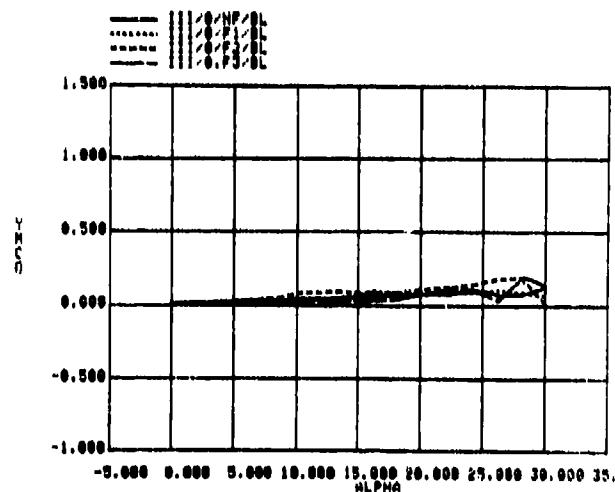


FIGURE A-13.6 FIN EFFECTS

FIGURE A-13. BODY AXIS FORCE & MOMENT FIN EFFECTS, MISSILE III.
ROLL 0, BLUNT NOSE.

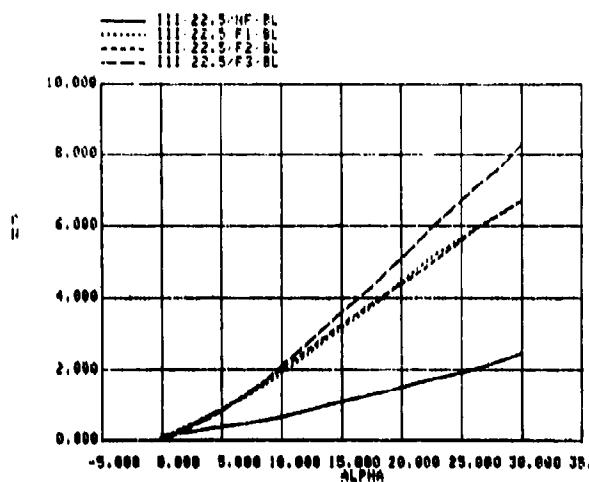


FIGURE A-14.1 FIN EFFECTS

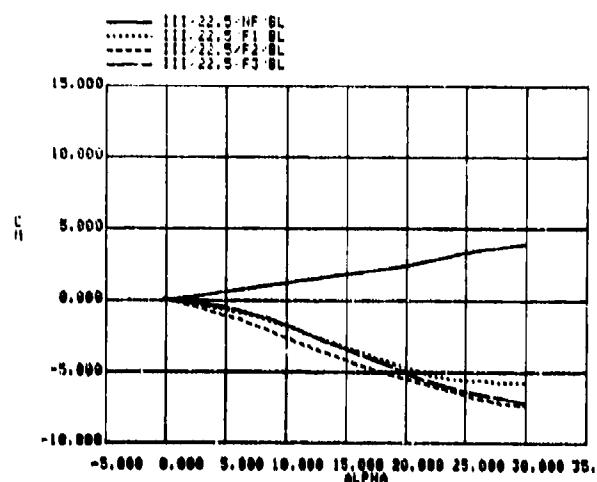


FIGURE A-14.4 FIN EFFECTS

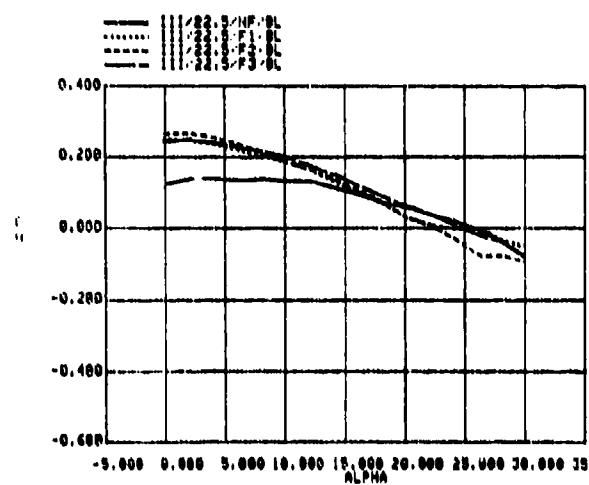


FIGURE A-14.2 FIN EFFECTS

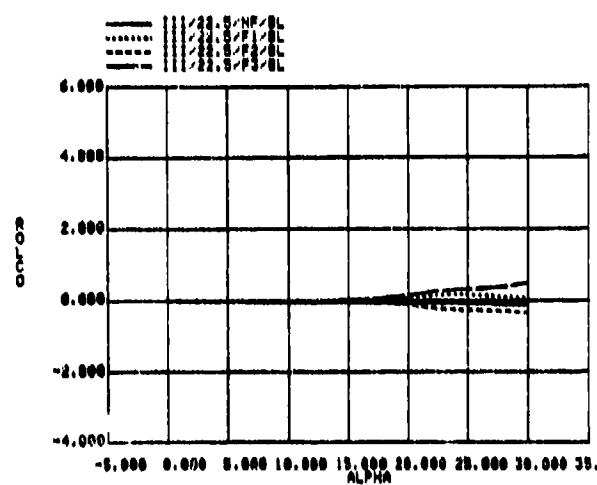


FIGURE A-14.5 FIN EFFECTS

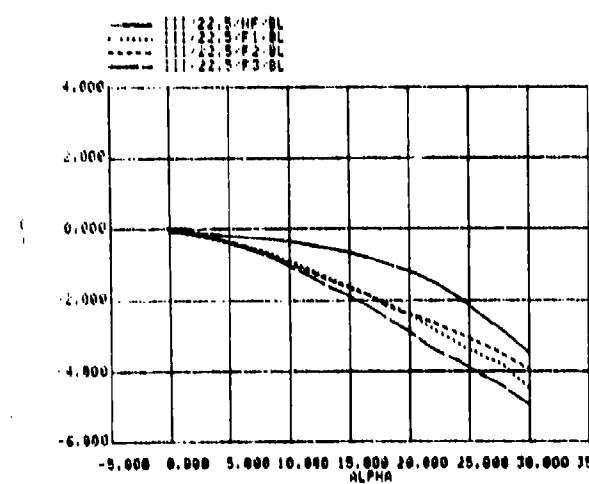


FIGURE A-14.3 FIN EFFECTS

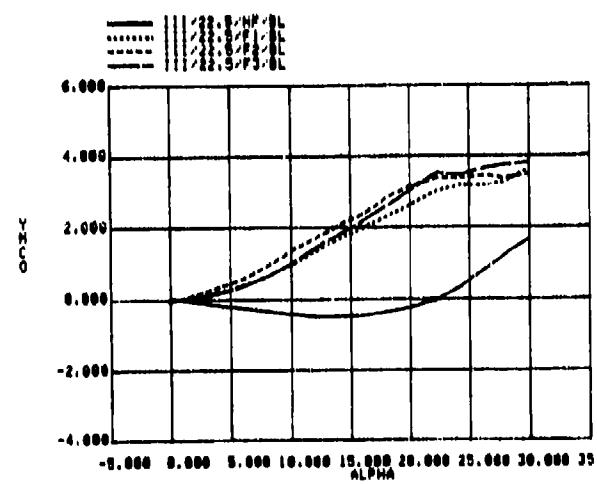


FIGURE A-14.6 FIN EFFECTS

FIGURE A-14. BODY AXIS FORCE & MOMENT FIN EFFECTS, MISSILE III.
ROLL 22, BLUNT NOSE.

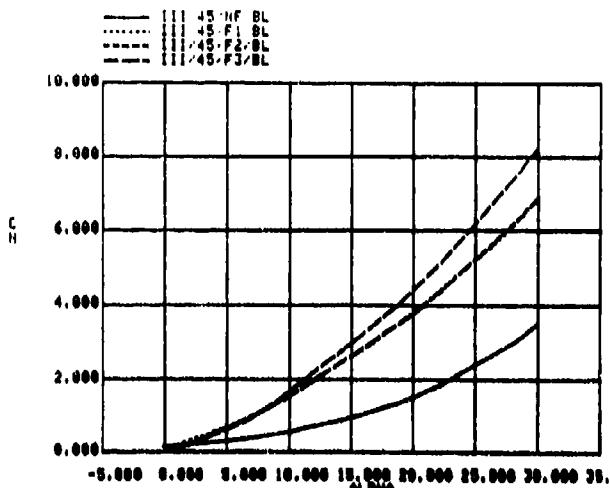


FIGURE A-15.1 FIN EFFECTS

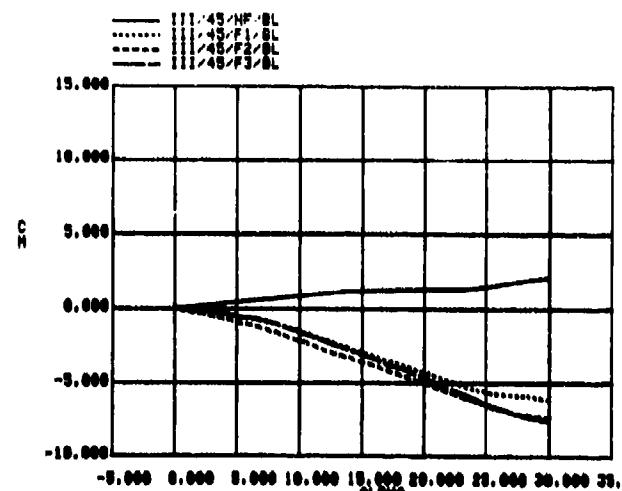


FIGURE A-15.4 FIN EFFECTS

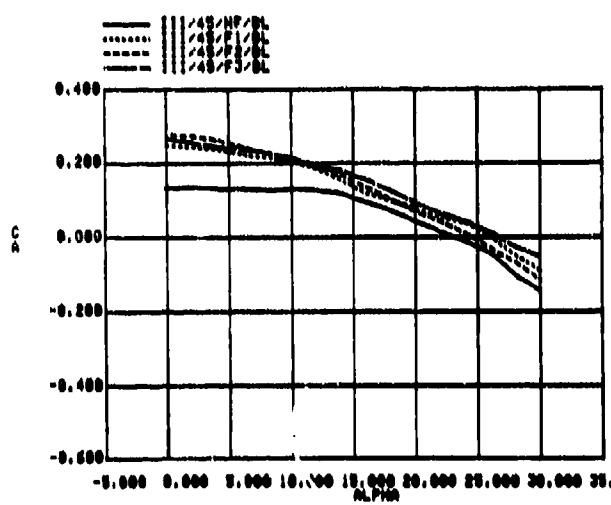


FIGURE A-15.2 FIN EFFECTS

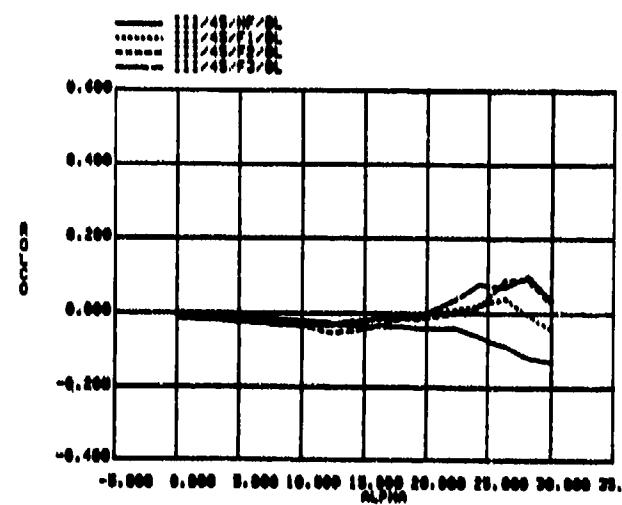


FIGURE A-15.5 FIN EFFECTS

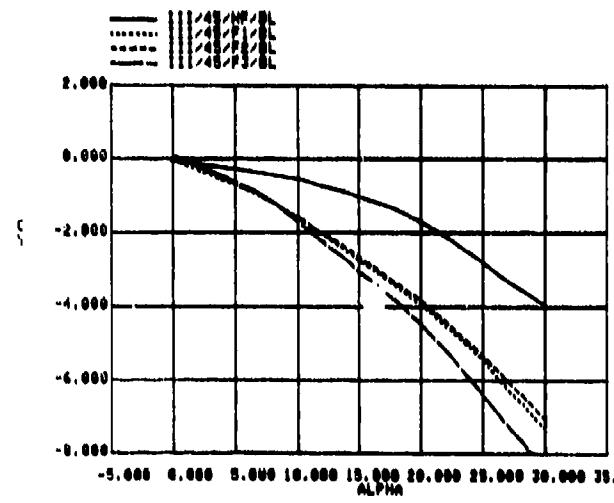


FIGURE A-15.3 FIN EFFECTS

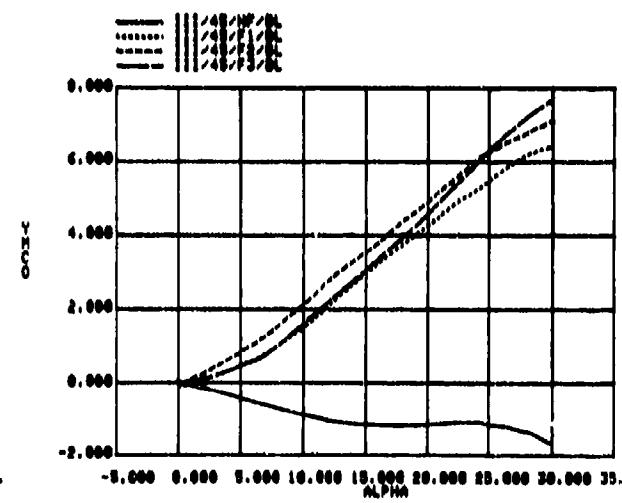


FIGURE A-15.6 FIN EFFECTS

FIGURE A-15. BODY AXIS FORCE & MOMENT FIN EFFECTS, MISSILE III,
ROLL 45, BLUNT NOSE.

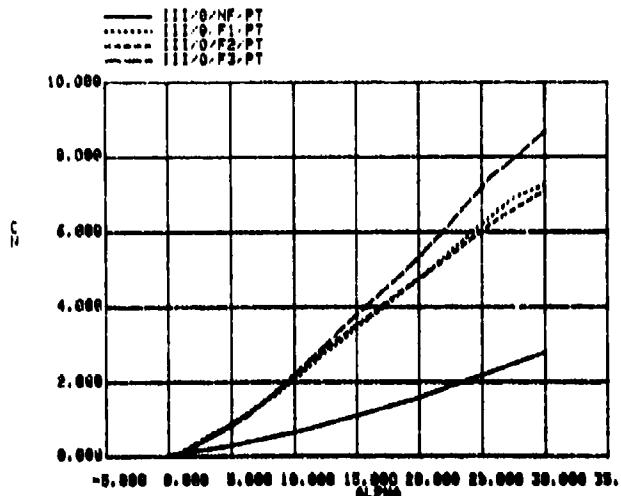


FIGURE A-16.1 FIN EFFECTS

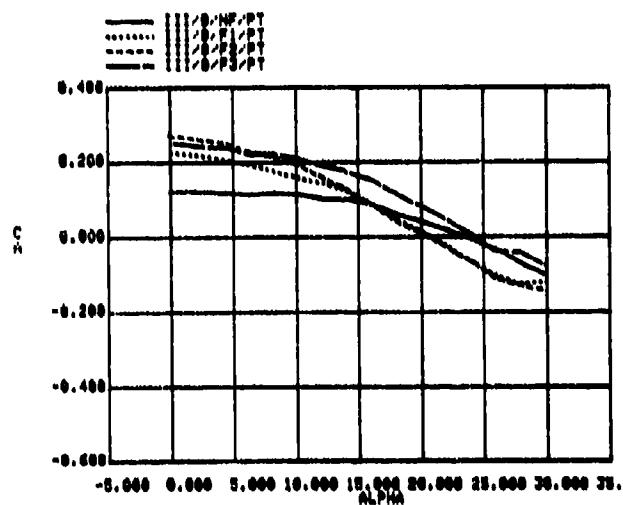


FIGURE A-16.2 FIN EFFECTS

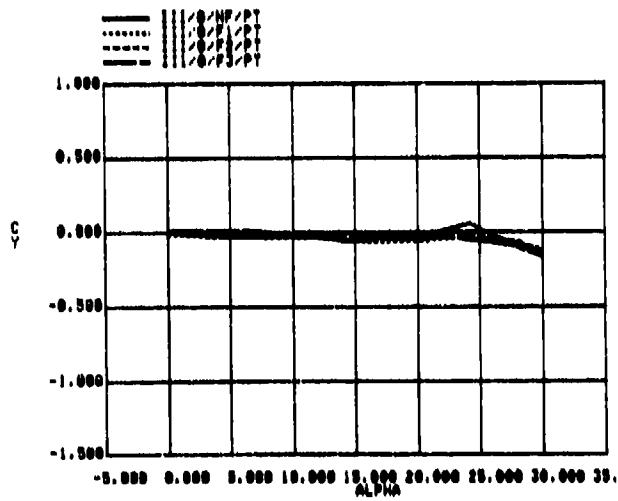


FIGURE A-16.3 FIN EFFECTS

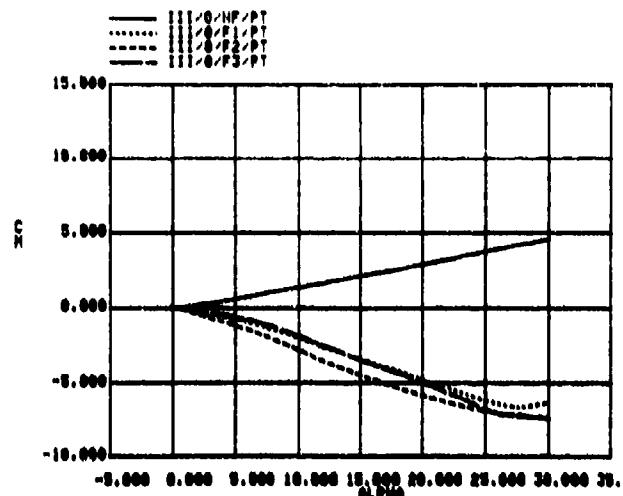


FIGURE A-16.4 FIN EFFECTS

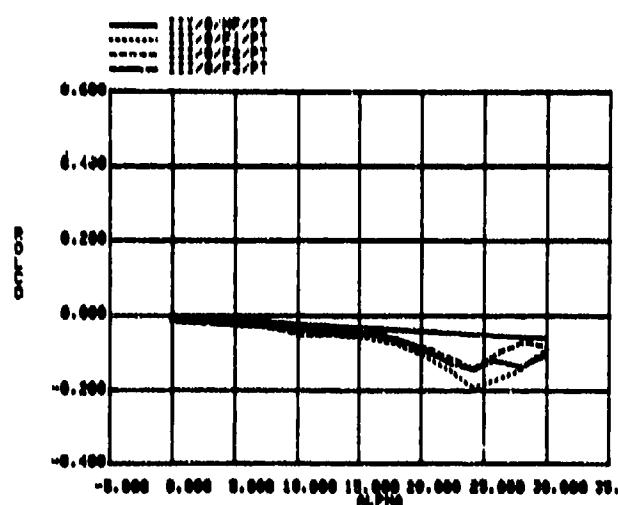


FIGURE A-16.5 FIN EFFECTS

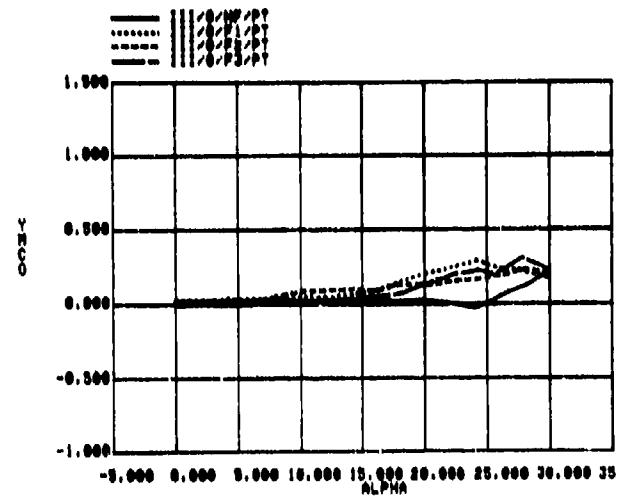


FIGURE A-16.6 FIN EFFECTS

FIGURE A-16. BODY AXIS FORCE & MOMENT FIN EFFECTS, MISSILE III.

ROLL 0, POINTED NOSE.

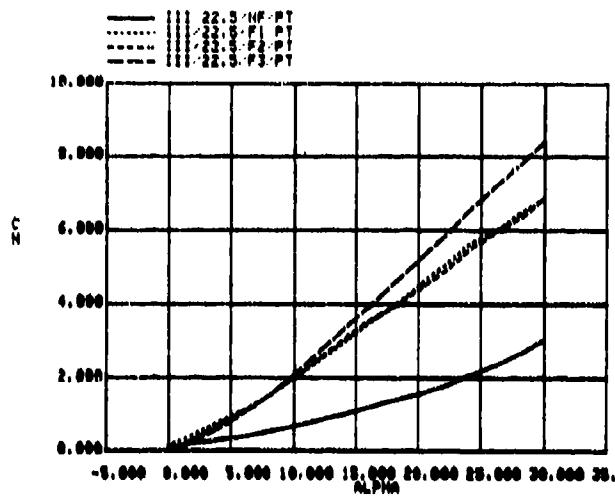


FIGURE A-17.1 FIN EFFECTS

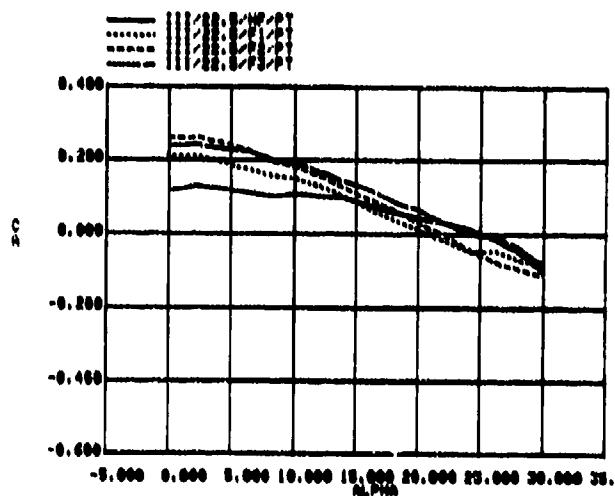


FIGURE A-17.2 FIN EFFECTS

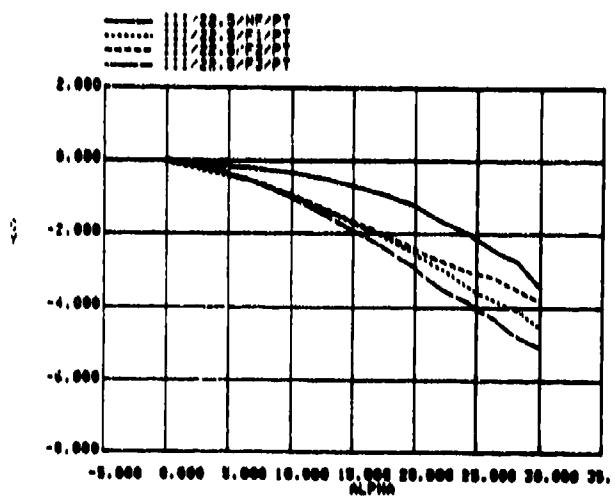


FIGURE A-17.3 FIN EFFECTS

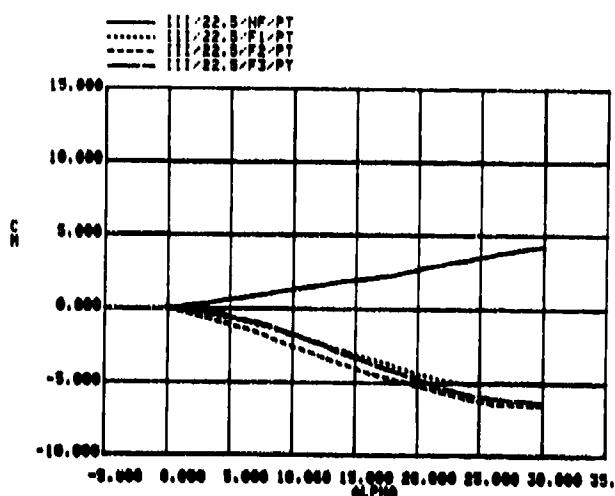


FIGURE A-17.4 FIN EFFECTS

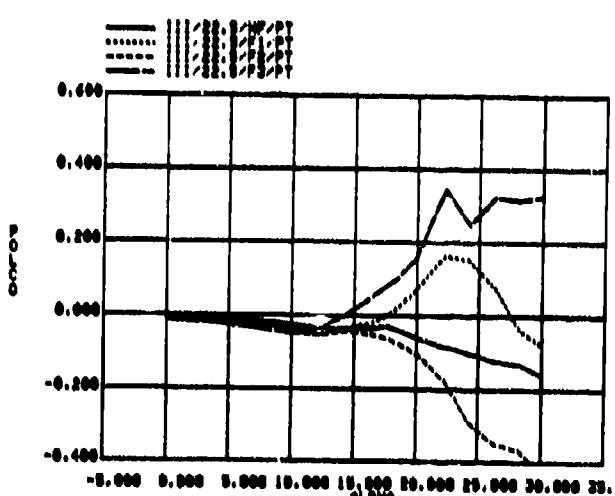


FIGURE A-17.5 FIN EFFECTS

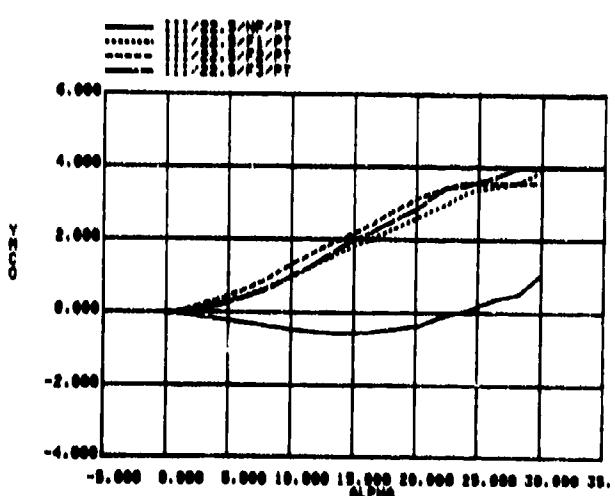


FIGURE A-17.6 FIN EFFECTS

FIGURE A-17. BODY AXIS FORCE & MOMENT FIN EFFECTS, MISSILE III.
ROLL 22, POINTED NOSE.

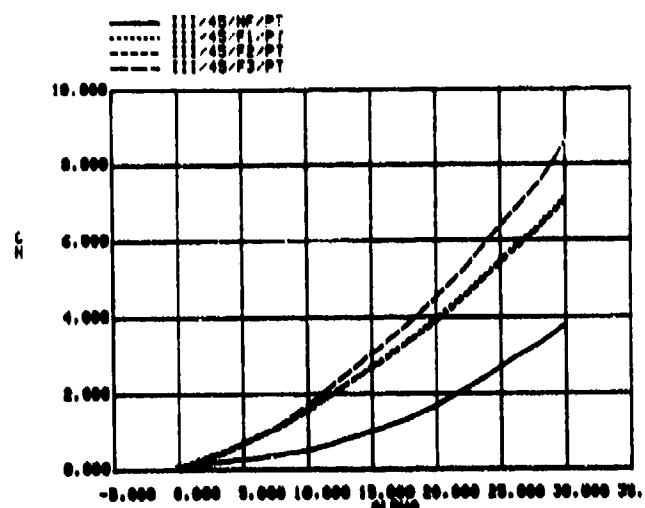


FIGURE A-18.1 FIN EFFECTS

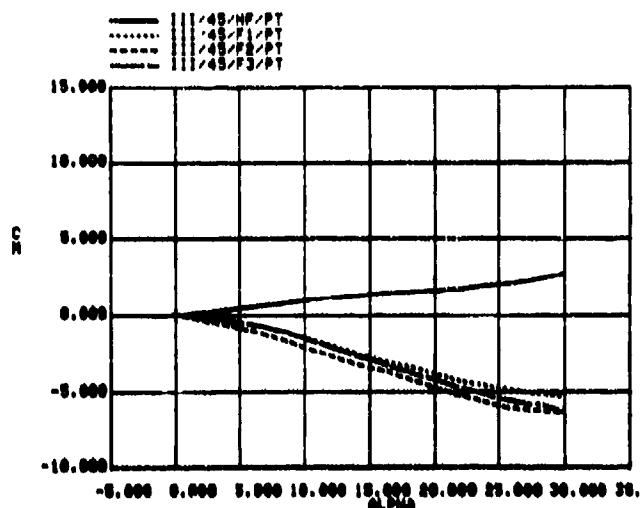


FIGURE A-18.4 FIN EFFECTS

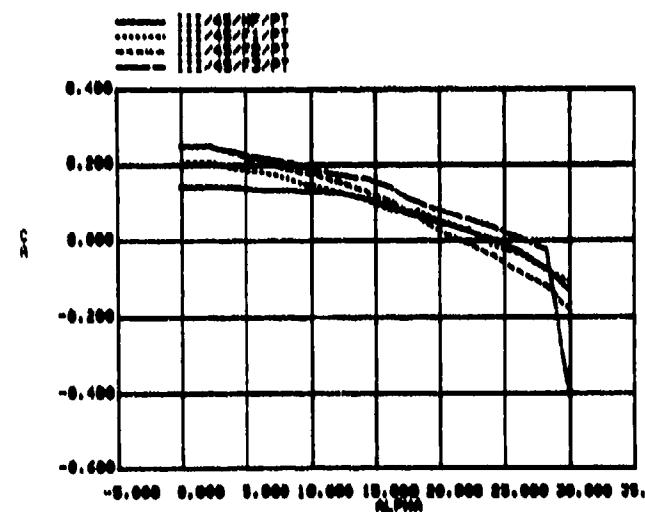


FIGURE A-18.2 FIN EFFECTS

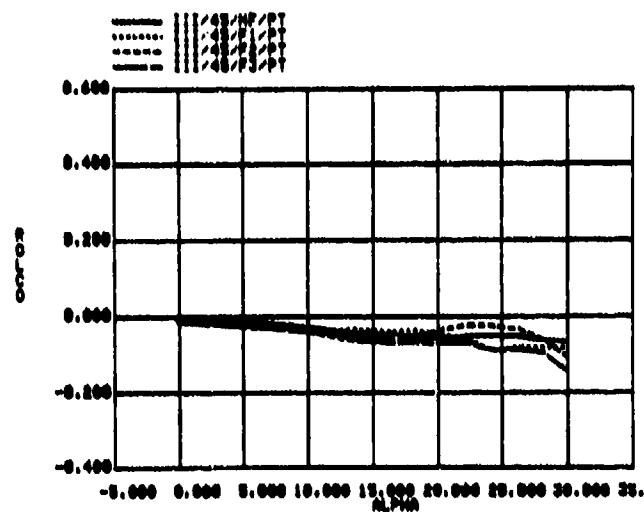


FIGURE A-18.5 FIN EFFECTS

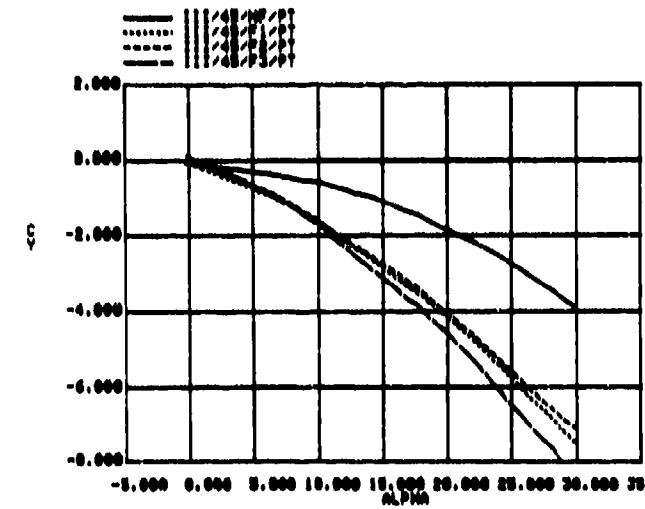


FIGURE A-18.3 FIN EFFECTS

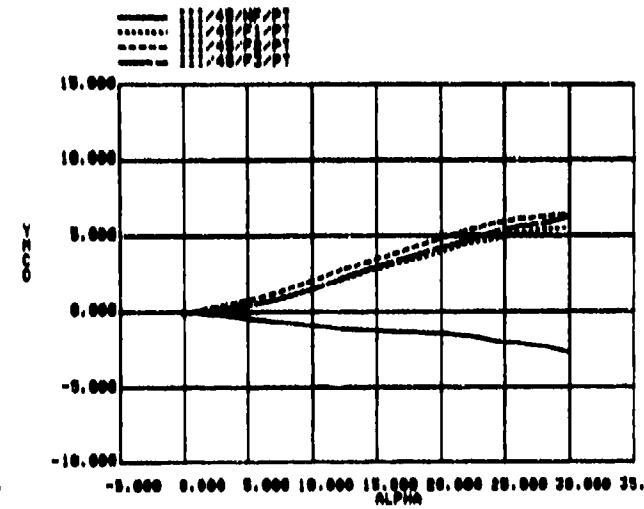


FIGURE A-18.6 FIN EFFECTS

FIGURE A-18. BODY AXIS FORCE & MOMENT FIN EFFECTS, MISSILE III.
ROLL 45, POINTED NOSE.

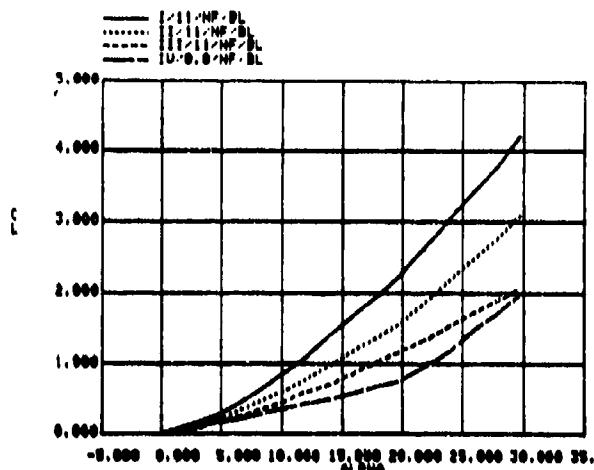


FIGURE A-19.1 BODY CORNER RADIUS EFFECTS

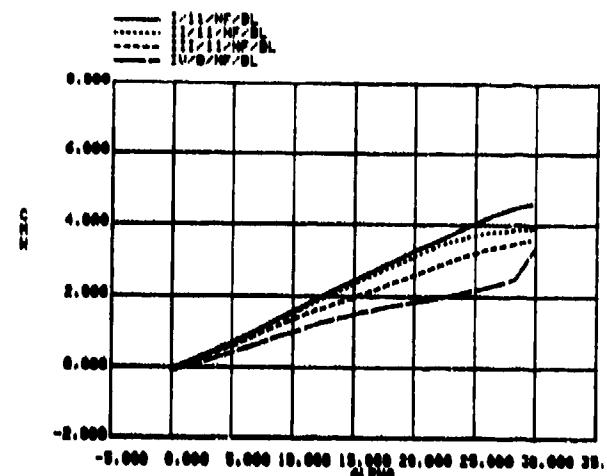


FIGURE A-19.4 BODY CORNER RADIUS EFFECTS

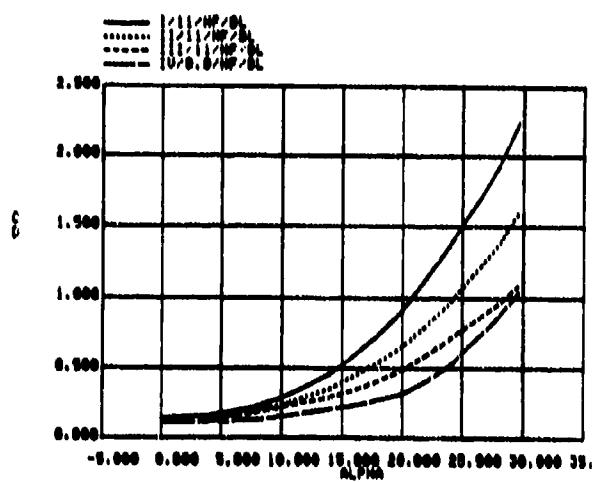


FIGURE A-19.2 BODY CORNER RADIUS EFFECTS

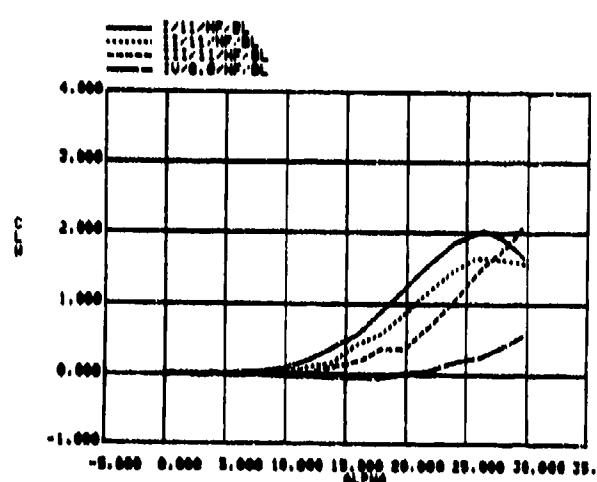


FIGURE A-19.5 BODY CORNER RADIUS EFFECTS

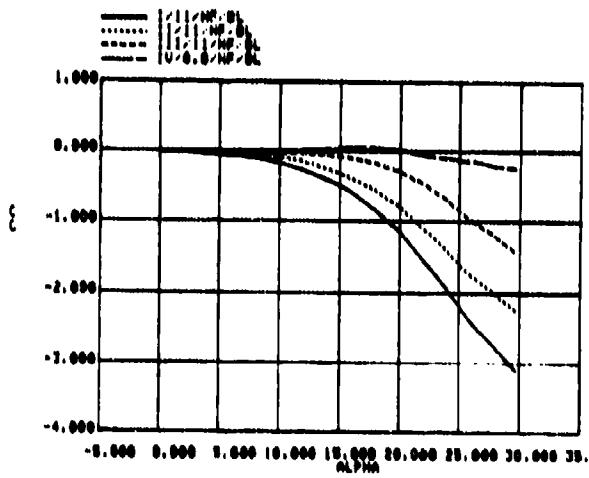


FIGURE A-19.3 BODY CORNER RADIUS EFFECTS

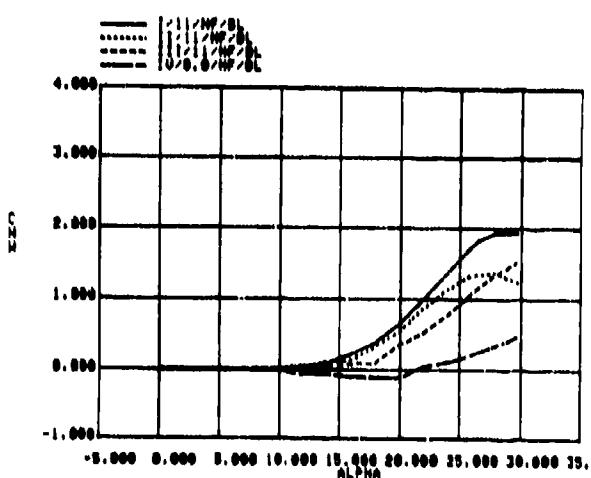


FIGURE A-19.6 BODY CORNER RADIUS EFFECTS

FIGURE A-19. WIND AXIS FORCE & MOMENT BODY EFFECTS, 11 ROLL ANGLE,
NO FINS, BLUNT NOSE.

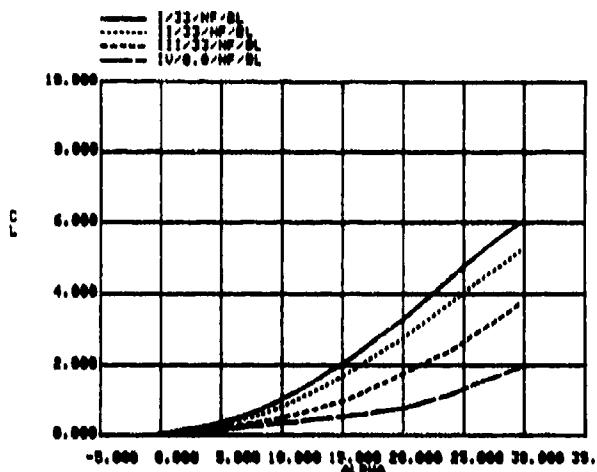


FIGURE A-20.1 BODY CORNER RADIUS EFFECTS

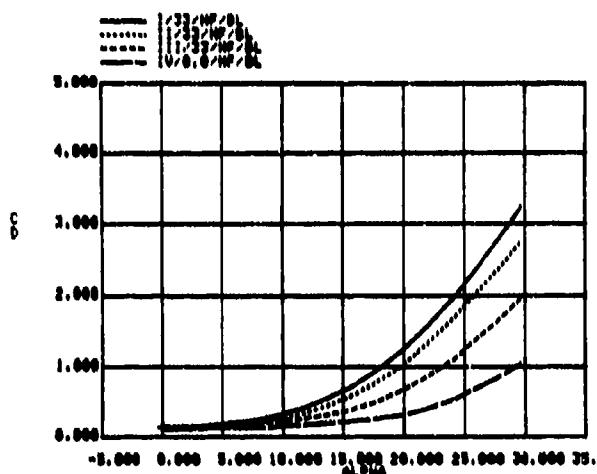


FIGURE A-20.2 BODY CORNER RADIUS EFFECTS

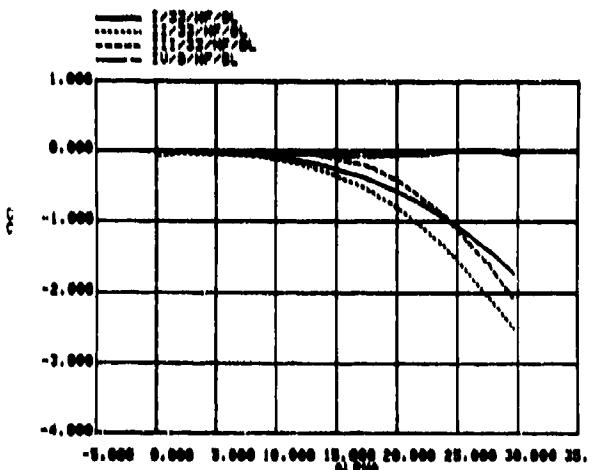


FIGURE A-20.3 BODY CORNER RADIUS EFFECTS

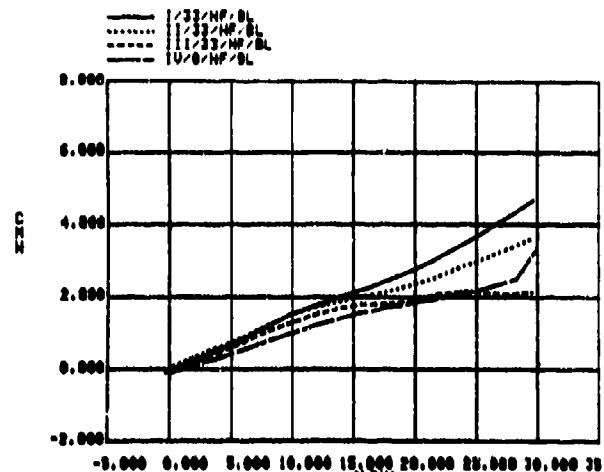


FIGURE A-20.4 BODY CORNER RADIUS EFFECTS

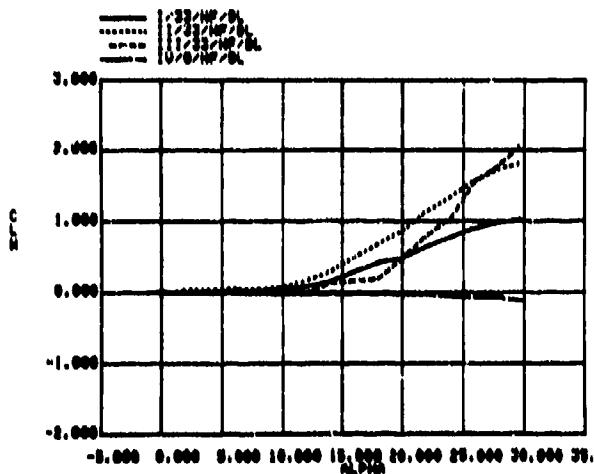


FIGURE A-20.5 BODY CORNER RADIUS EFFECTS

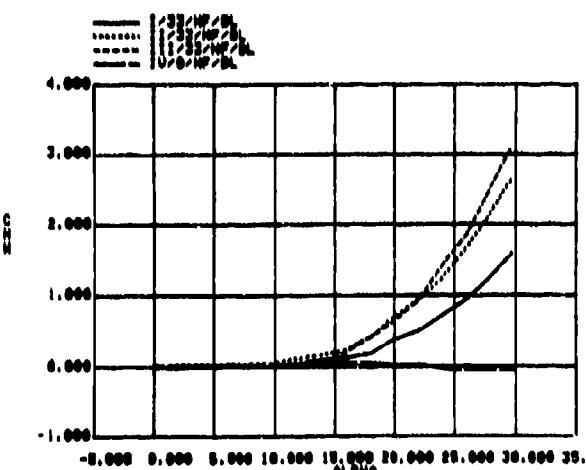


FIGURE A-20.6 BODY CORNER RADIUS EFFECTS

FIGURE A-20. WIND AXIS FORCE & MOMENT BODY EFFECTS, 33 ROLL ANGLE.
NO FINS, BLUNT NOSE.

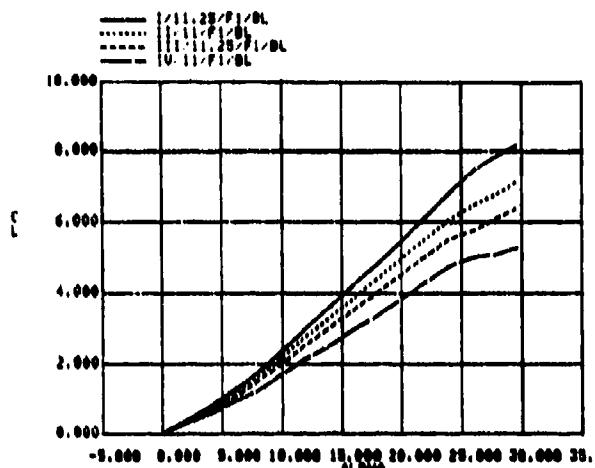


FIGURE A-21.1 BODY CORNER RADIUS EFFECTS

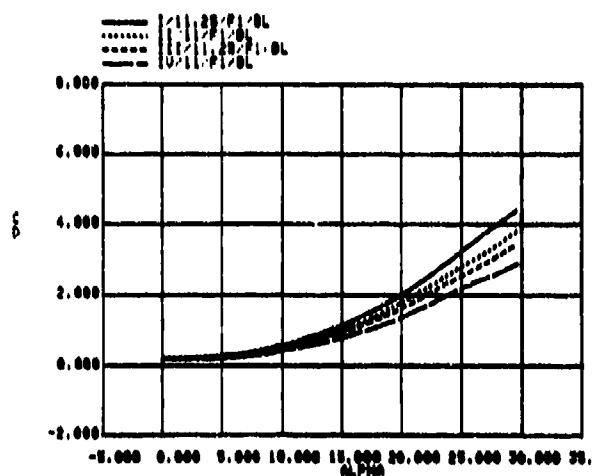


FIGURE A-21.2 BODY CORNER RADIUS EFFECTS

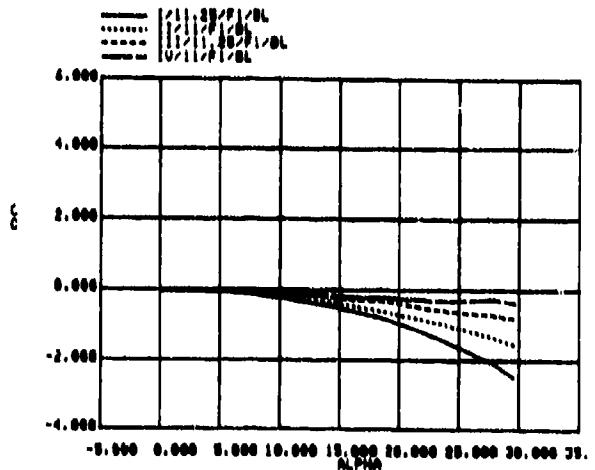


FIGURE A-21.3 BODY CORNER RADIUS EFFECTS

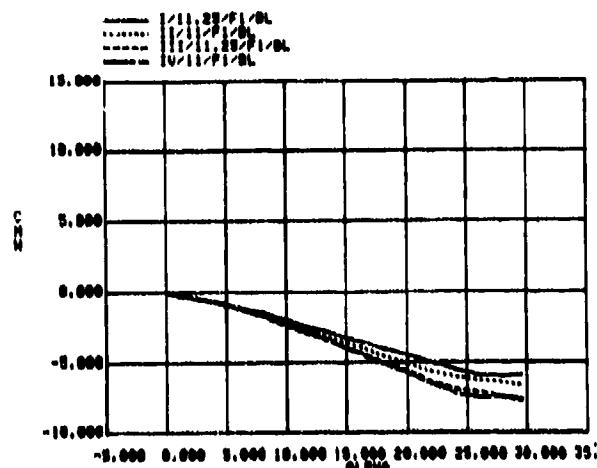


FIGURE A-21.4 BODY CORNER RADIUS EFFECTS

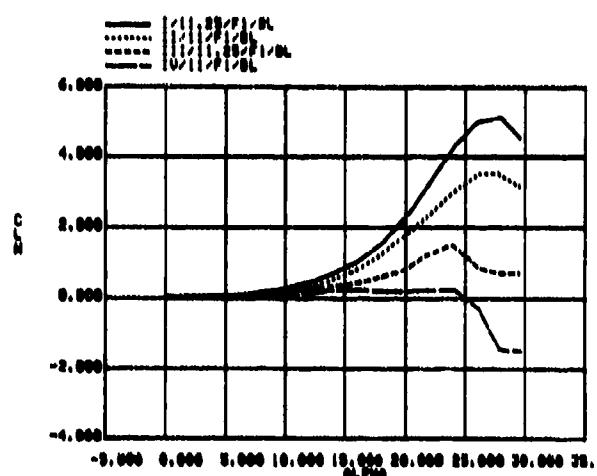


FIGURE A-21.5 BODY CORNER RADIUS EFFECTS

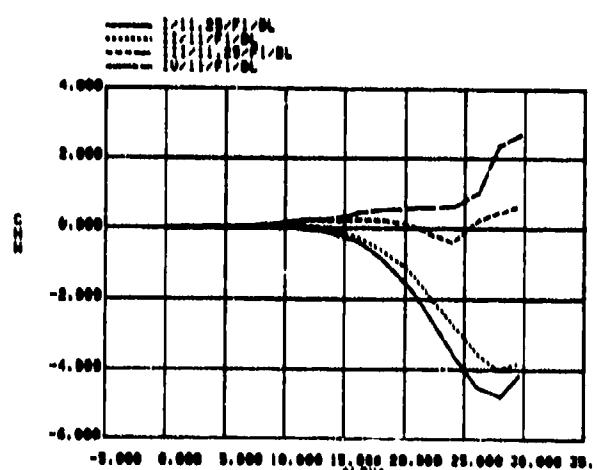


FIGURE A-21.6 BODY CORNER RADIUS EFFECTS

FIGURE A-21. WIND AXIS FORCE & MOMENT BODY EFFECTS, 11 ROLL ANGLE.
FIN 1, BLUNT NOSE.

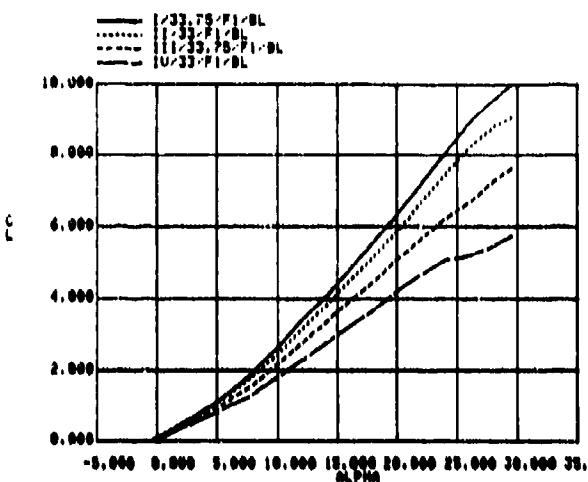


FIGURE A-22.1 BODY CORNER RADIUS EFFECTS

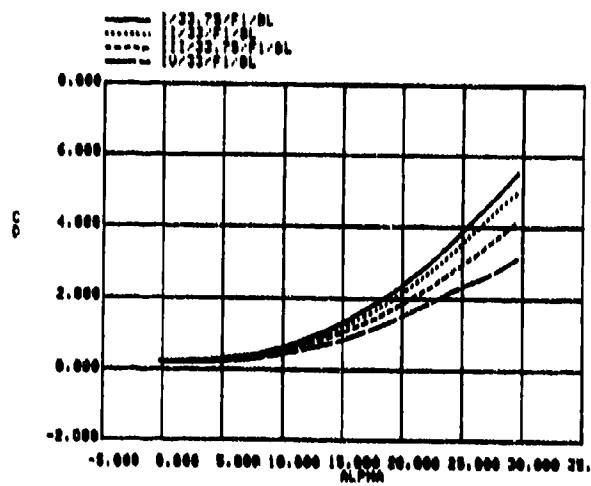


FIGURE A-22.2 BODY CORNER RADIUS EFFECTS

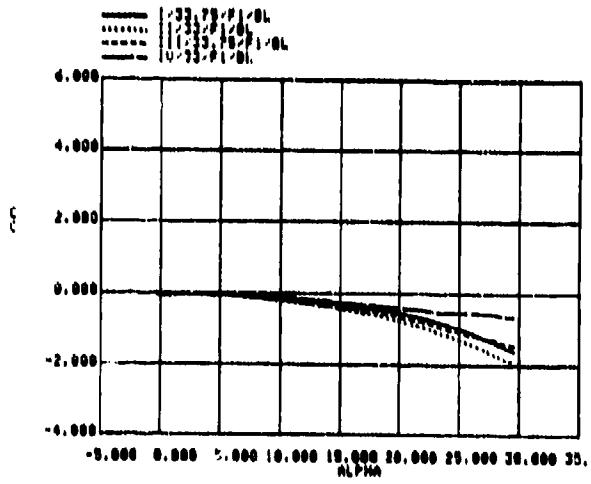


FIGURE A-22.3 BODY CORNER RADIUS EFFECTS

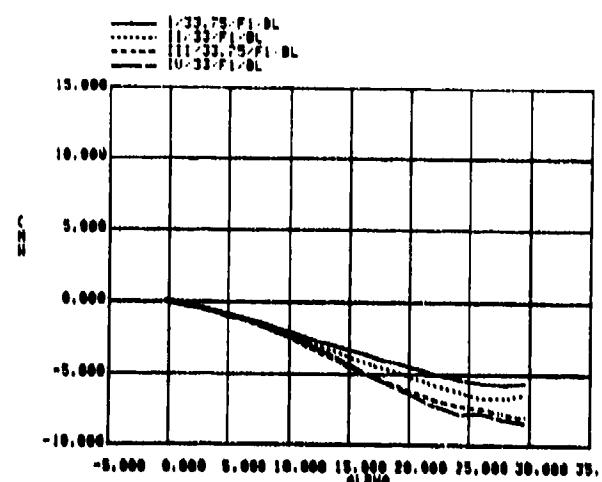


FIGURE A-22.4 BODY CORNER RADIUS EFFECTS

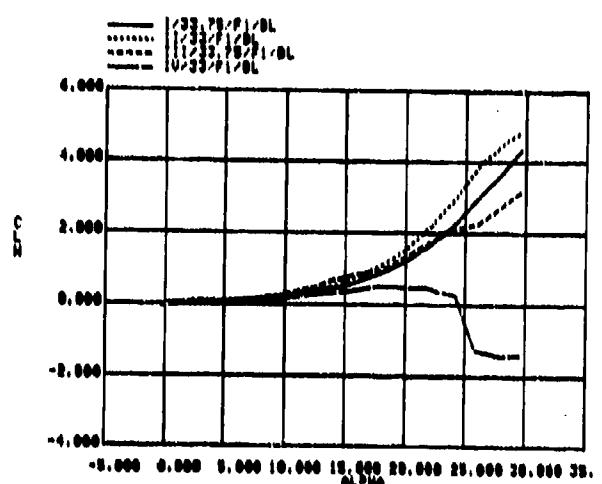


FIGURE A-22.5 BODY CORNER RADIUS EFFECTS

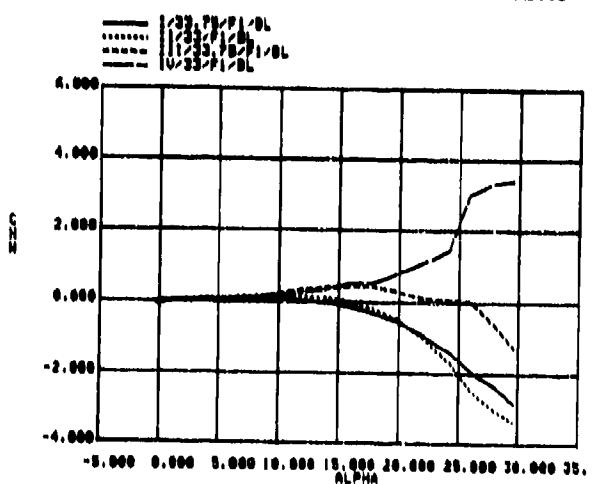


FIGURE A-22.6 BODY CORNER RADIUS EFFECTS

FIGURE A-22. WIND AXIS FORCE & MOMENT BODY EFFECTS, 33 ROLL ANGLE.

FIN 1, BLUNT NOSE.

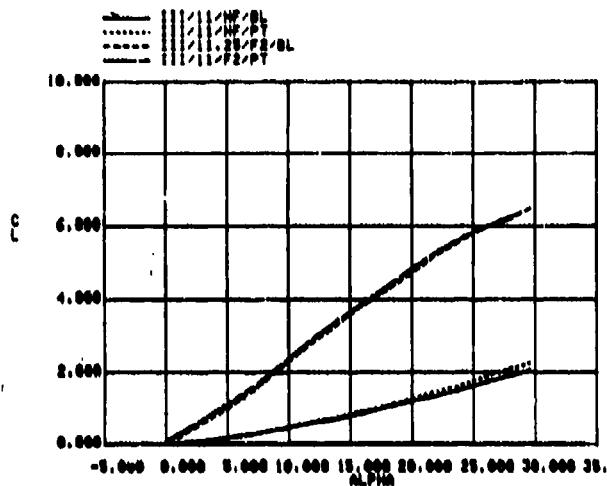


FIGURE A-23.1 NOSE EFFECTS

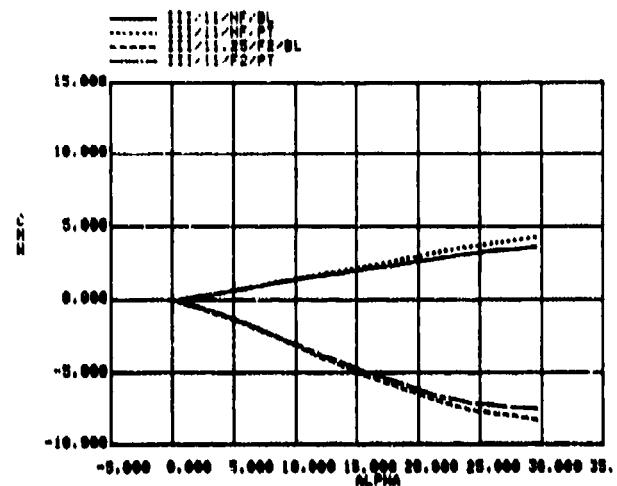


FIGURE A-23.4 NOSE EFFECTS

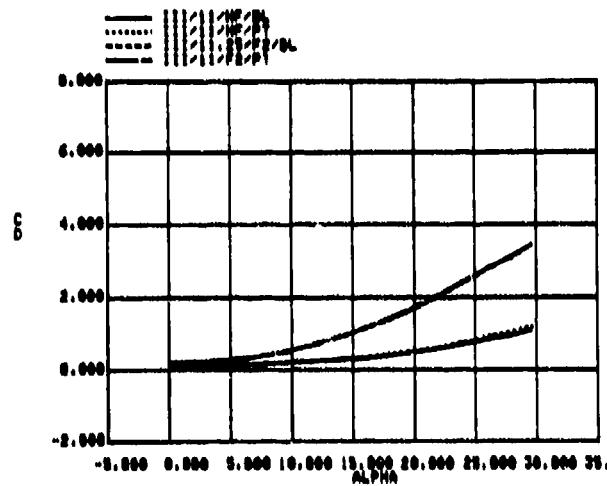


FIGURE A-23.2 NOSE EFFECTS

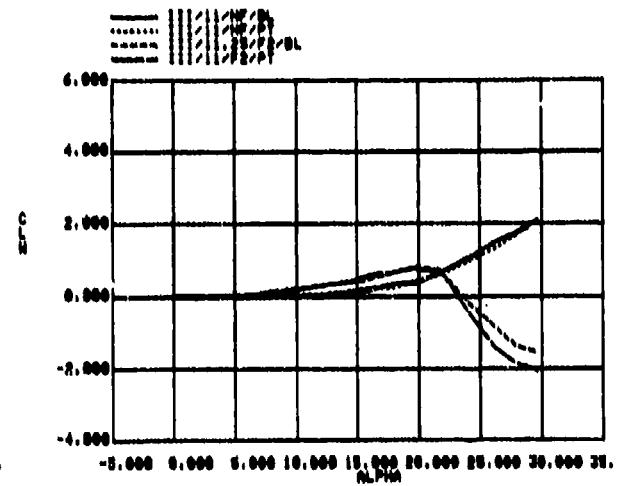


FIGURE A-23.5 NOSE EFFECTS

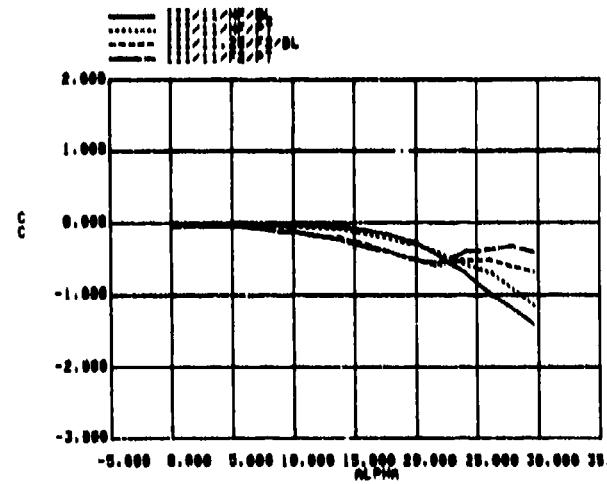


FIGURE A-23.3 NOSE EFFECTS

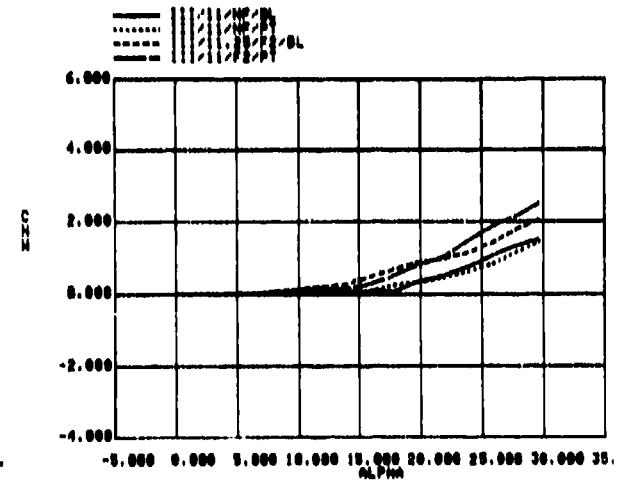


FIGURE A-23.6 NOSE EFFECTS

FIGURE A-23. WIND AXIS FORCE & MOMENT NOSE EFFECTS, MISSILE III,
ROLL 11, NO FIN/FIN 2, BLUNT/POINTED NOSE.

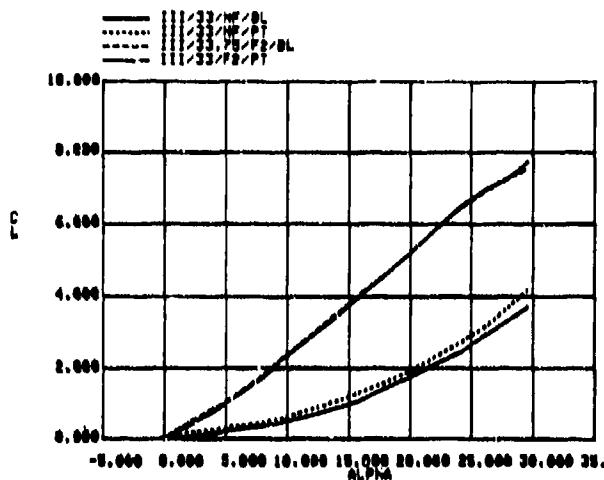


FIGURE A-24.1 NOSE EFFECTS

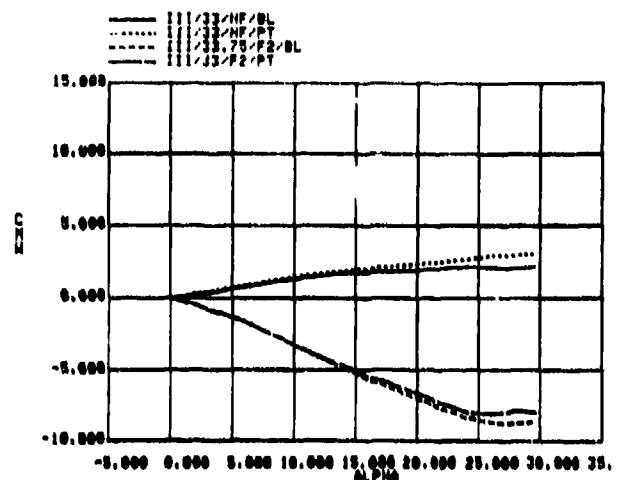


FIGURE A-24.4 NOSE EFFECTS

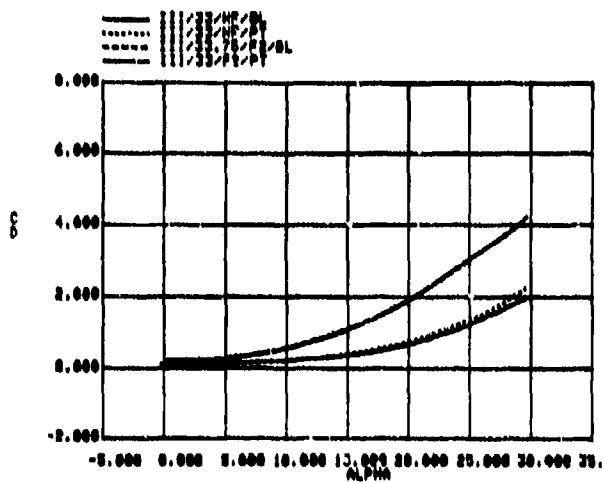


FIGURE A-24.2 NOSE EFFECTS

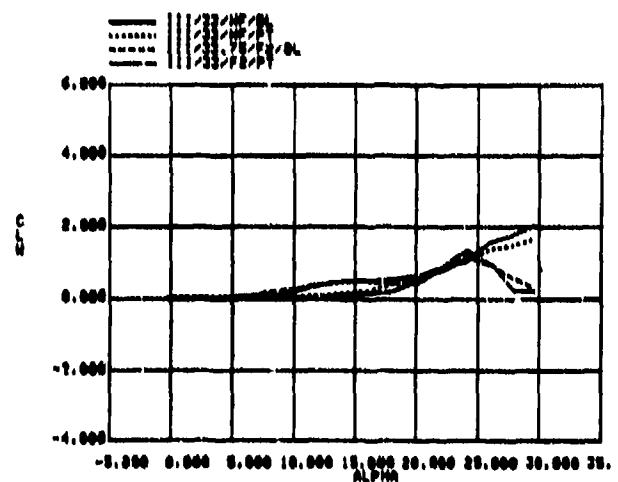


FIGURE A-24.5 NOSE EFFECTS

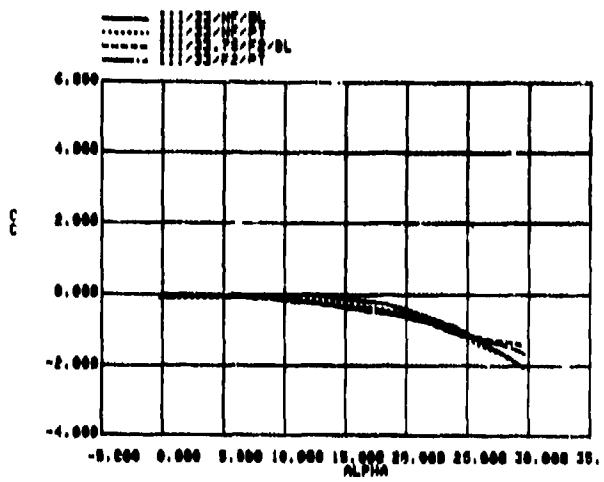


FIGURE A-24.3 NOSE EFFECTS

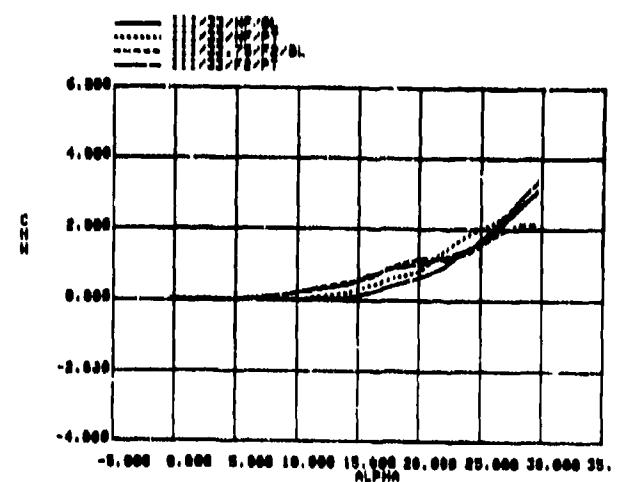


FIGURE A-24.6 NOSE EFFECTS

FIGURE A-24. WIND AXIS FORCE & MOMENT NOSE EFFECTS, MISSILE III.

ROLL 33, NO FIN/FIN 2, BLUNT/POINTED NOSE.

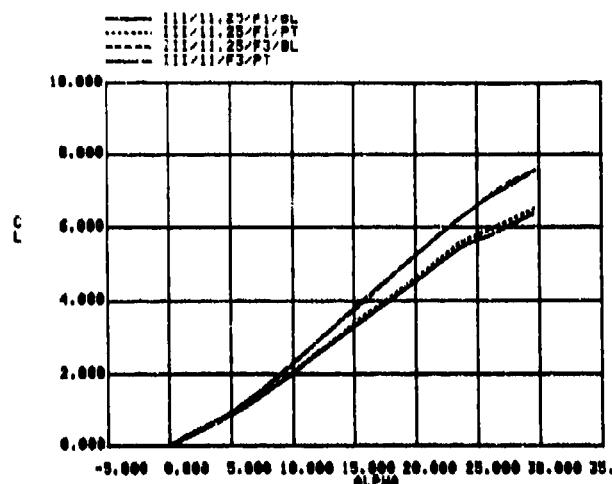


FIGURE A-25.1 NOSE EFFECTS

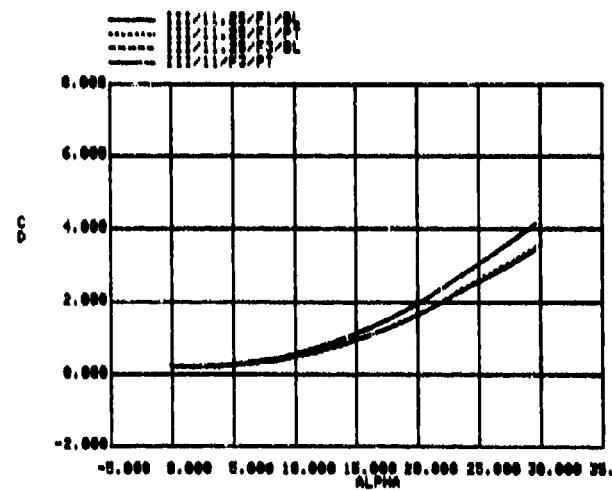


FIGURE A-25.2 NOSE EFFECTS

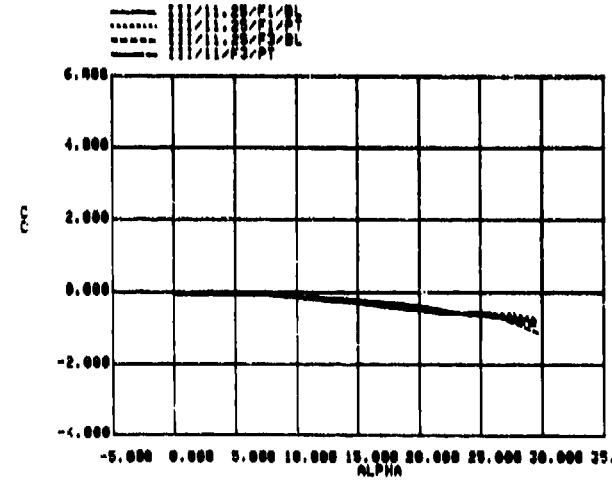


FIGURE A-25.3 NOSE EFFECTS

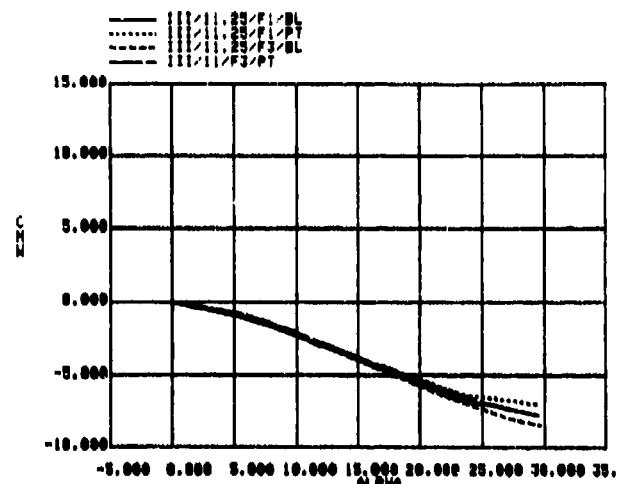


FIGURE A-25.4 NOSE EFFECTS

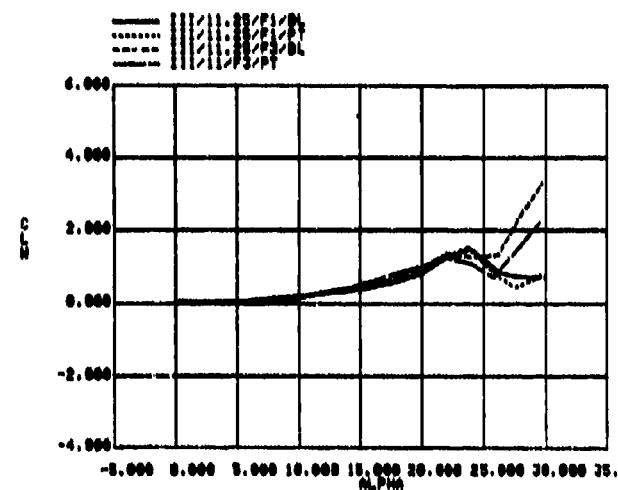


FIGURE A-25.5 NOSE EFFECTS

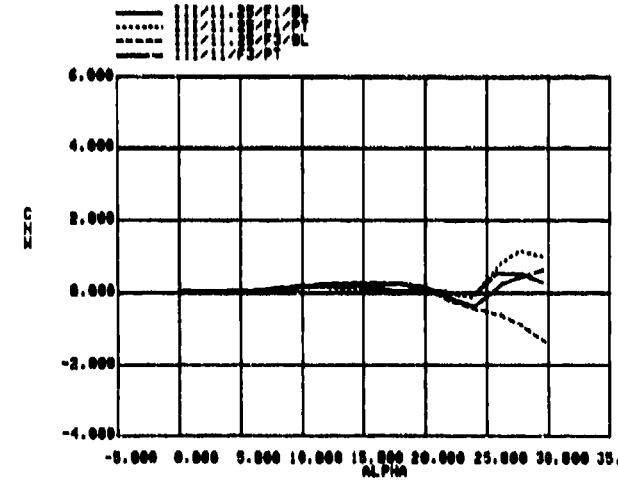


FIGURE A-25.6 NOSE EFFECTS

FIGURE A-25. WIND AXIS FORCE & MOMENT NOSE EFFECTS, MISSILE III.
ROLL 11, FIN 1/FIN 3, BLUNT/POINTED NOSE.

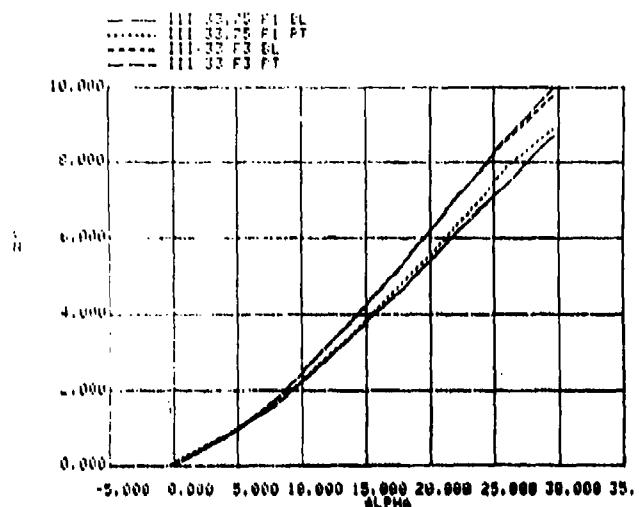


FIGURE A-26.1 NOSE EFFECTS

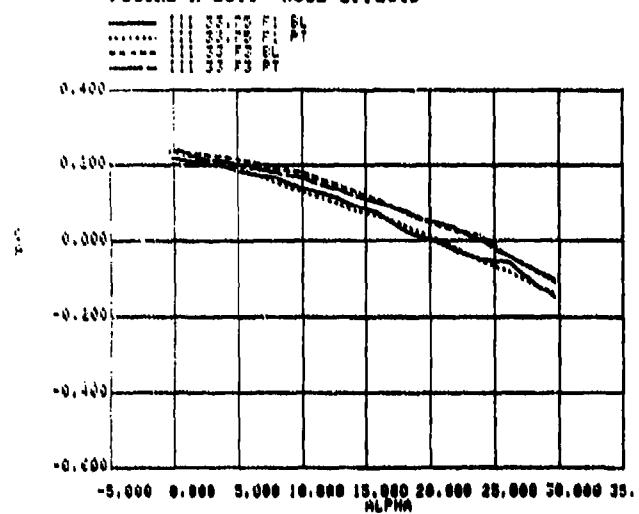


FIGURE A-26.2 NOSE EFFECTS

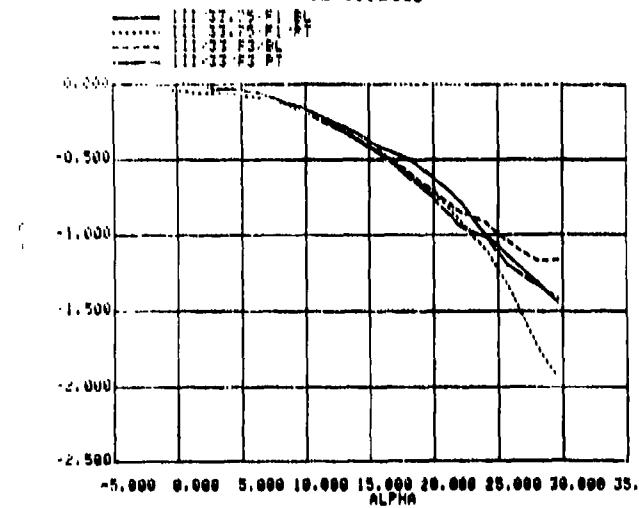


FIGURE A-26.3 NOSE EFFECTS

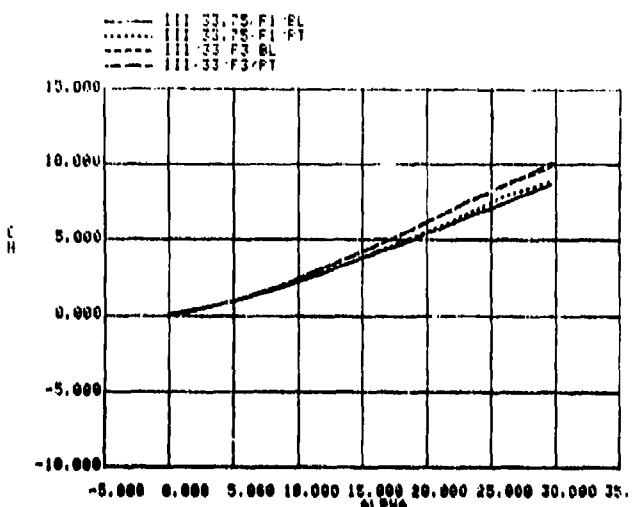


FIGURE A-26.4 NOSE EFFECTS

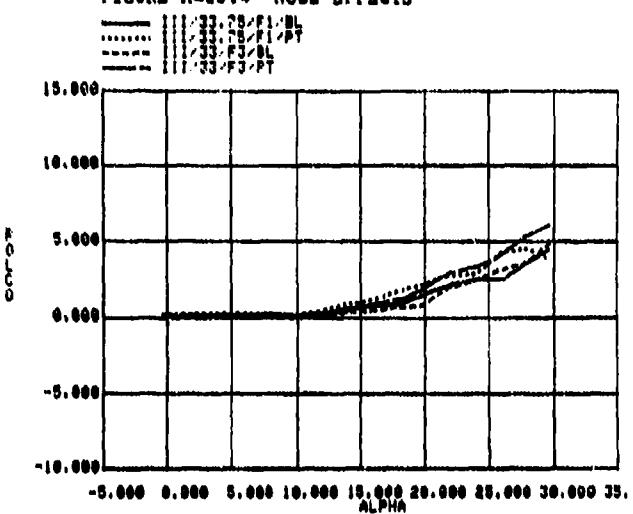


FIGURE A-26.5 NOSE EFFECTS

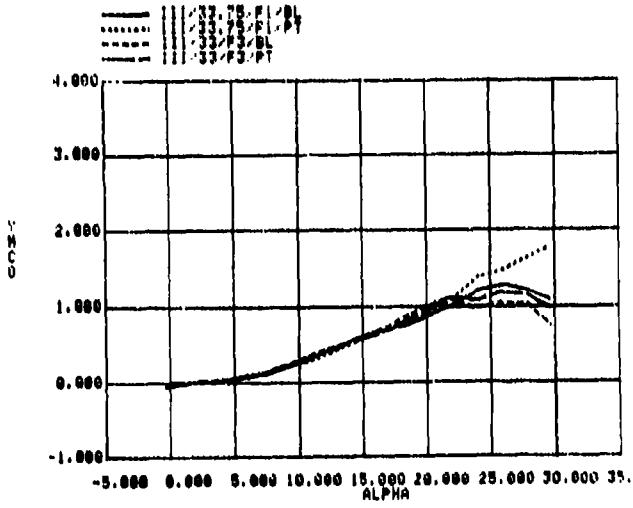


FIGURE A-26.6 NOSE EFFECTS

FIGURE A-26. WIND AXIS FORCE & MOMENT NOSE EFFECTS, MISSILE III.
ROLL 33, FIN 1/FIN 3, BLUNT/POINTED NOSE.

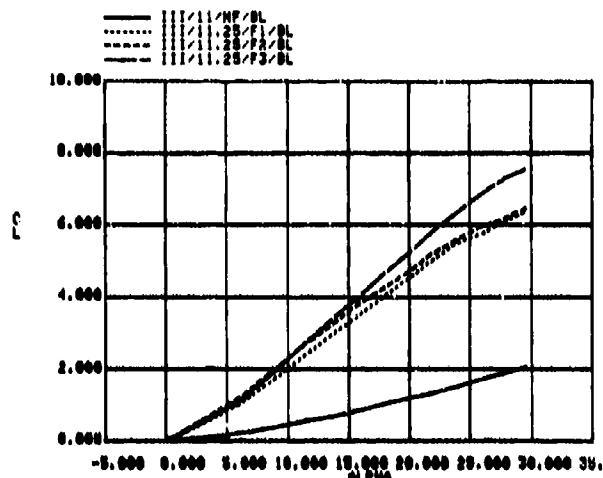


FIGURE A-27.1 FIN EFFECTS

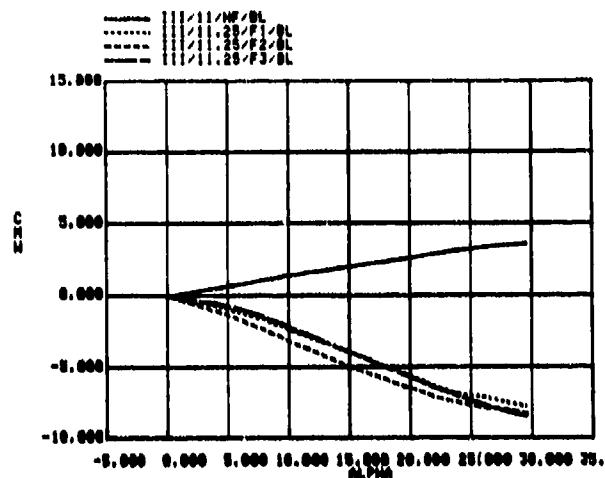


FIGURE A-27.4 FIN EFFECTS

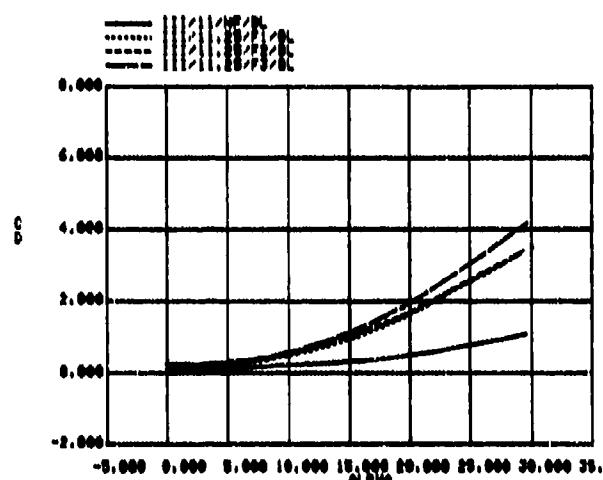


FIGURE A-27.2 FIN EFFECTS

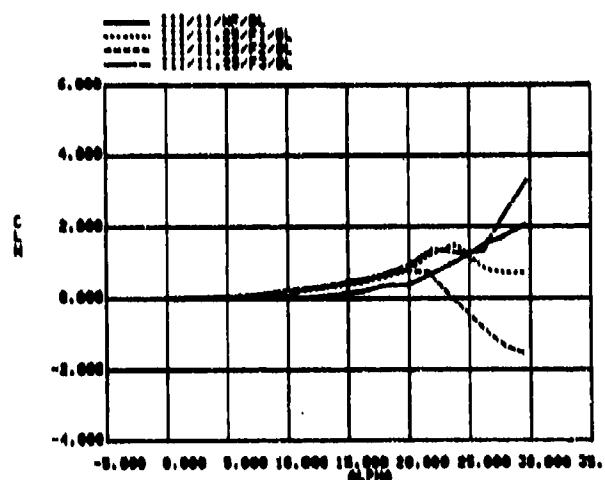


FIGURE A-27.5 FIN EFFECTS

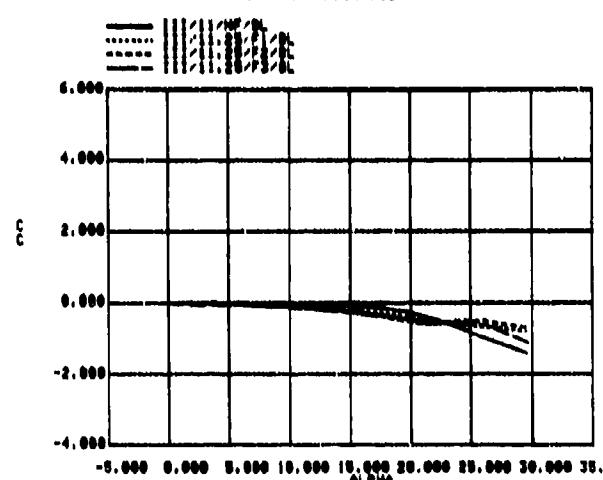


FIGURE A-27.3 FIN EFFECTS

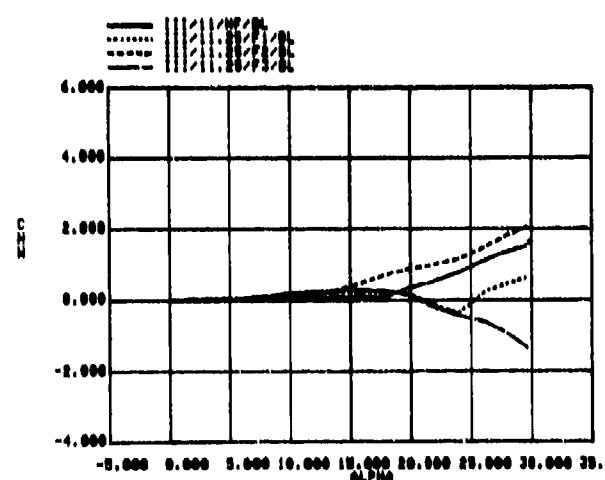


FIGURE A-27.6 FIN EFFECTS

FIGURE A-27. WIND AXIS FORCE & MOMENT FIN EFFECTS, MISSILE III.

ROLL 11, BLUNT NOSE.

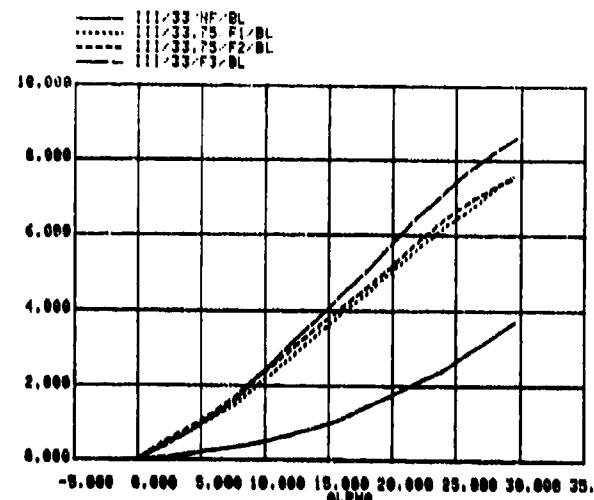


FIGURE A-28.1 FIN EFFECTS

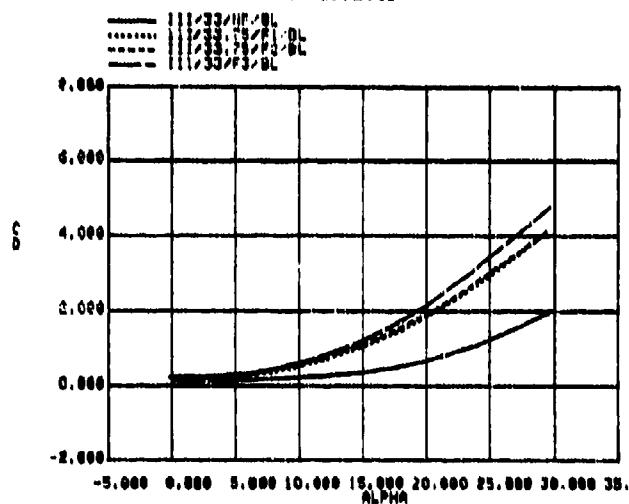


FIGURE A-28.2 FIN EFFECTS

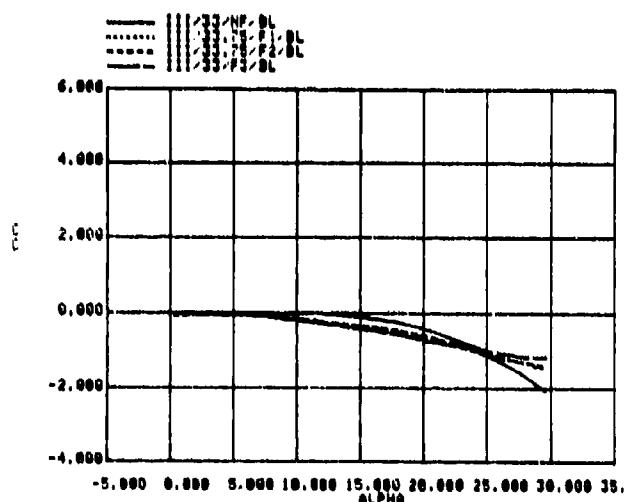


FIGURE A-28.3 FIN EFFECTS

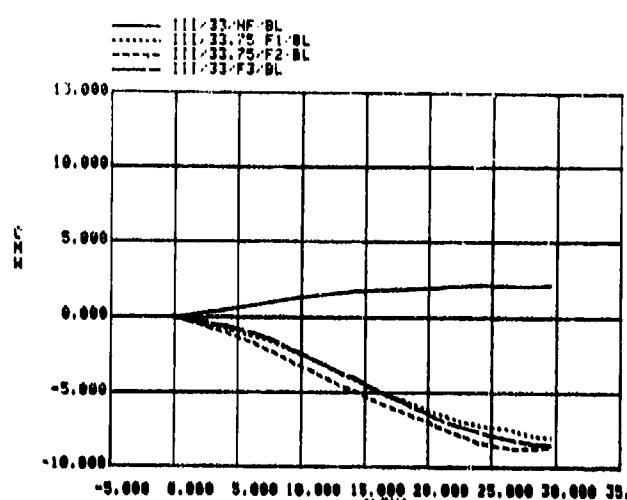


FIGURE A-28.4 FIN EFFECTS

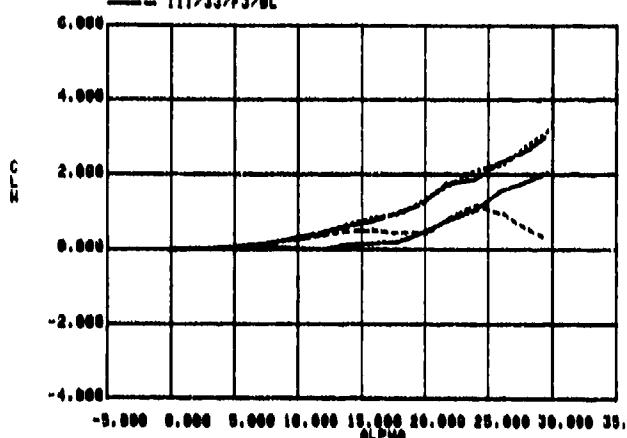


FIGURE A-28.5 FIN EFFECTS

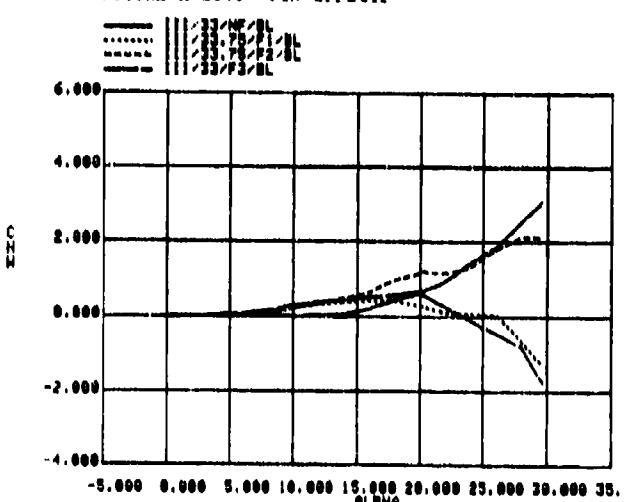


FIGURE A-28.6 FIN EFFECTS

FIGURE A-28. WIND AXIS FORCE & MOMENT FIN EFFECTS, MISSILE III.

ROLL 33, BLUNT NOSE.

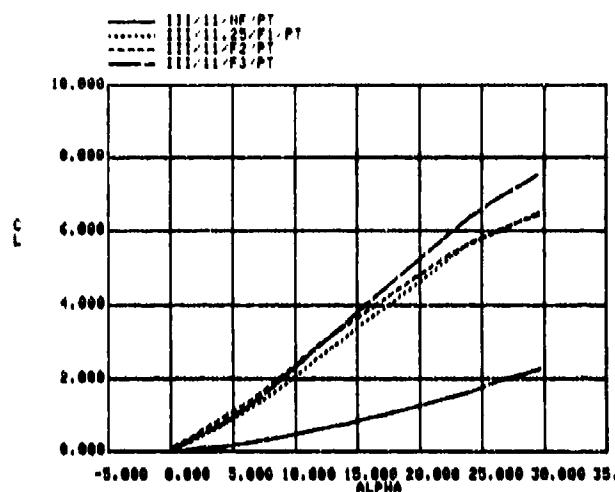


FIGURE A-29.1 FIN EFFECTS

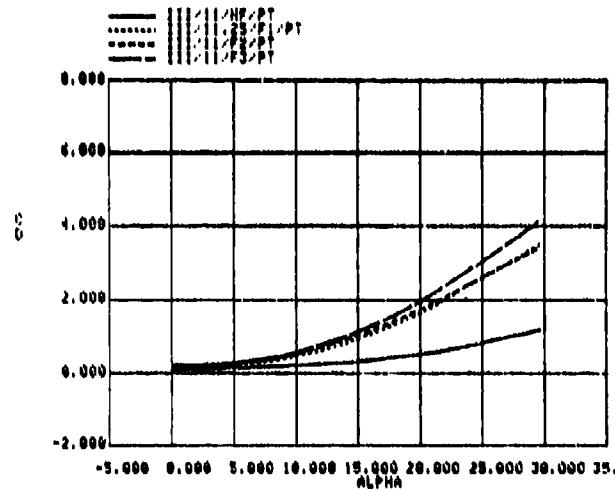


FIGURE A-29.2 FIN EFFECTS

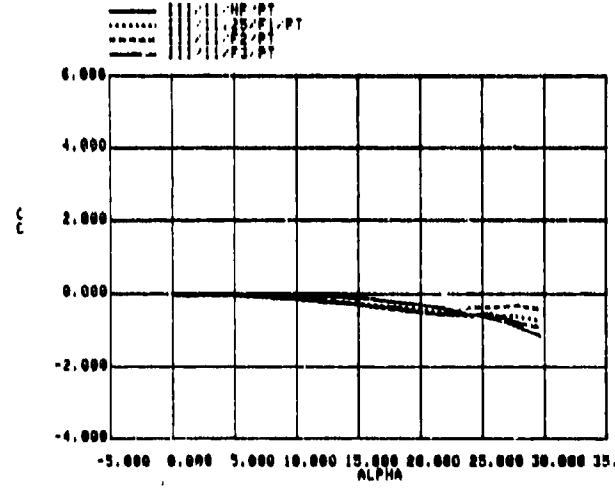


FIGURE A-29.3 FIN EFFECTS

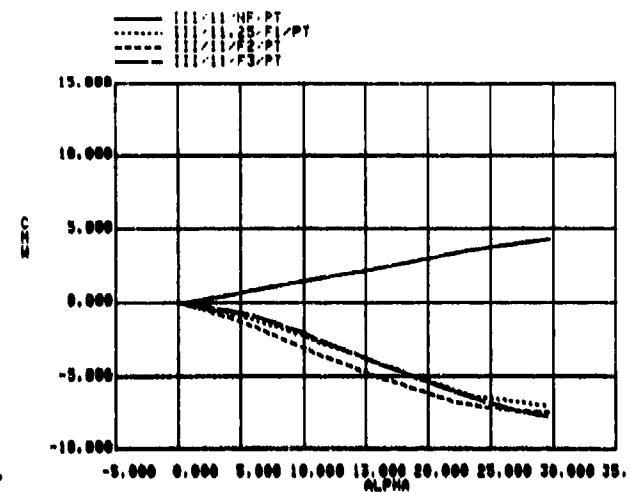


FIGURE A-29.4 FIN EFFECTS

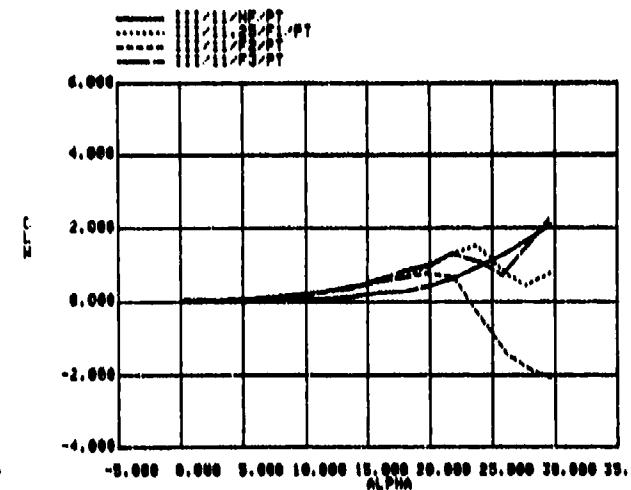


FIGURE A-29.5 FIN EFFECTS

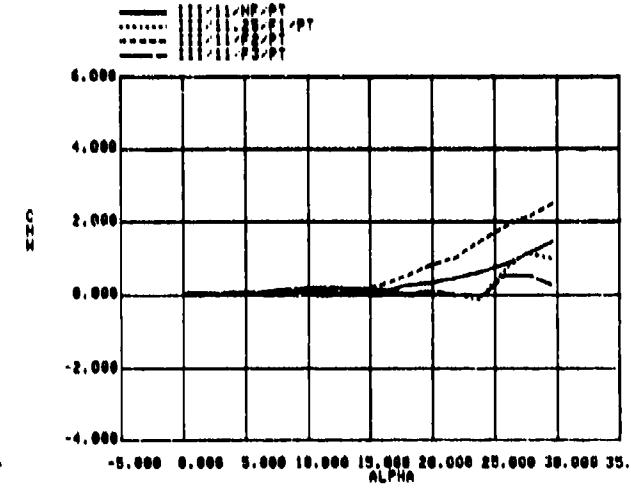


FIGURE A-29.6 FIN EFFECTS

FIGURE A-29. WIND AXIS FORCE & MOMENT FIN EFFECTS, MISSILE III.

ROLL 11, POINTED NOSE.

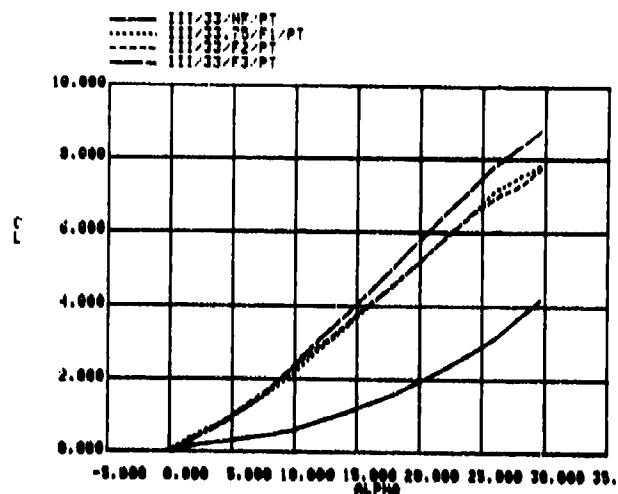


FIGURE A-30.1 FIN EFFECTS

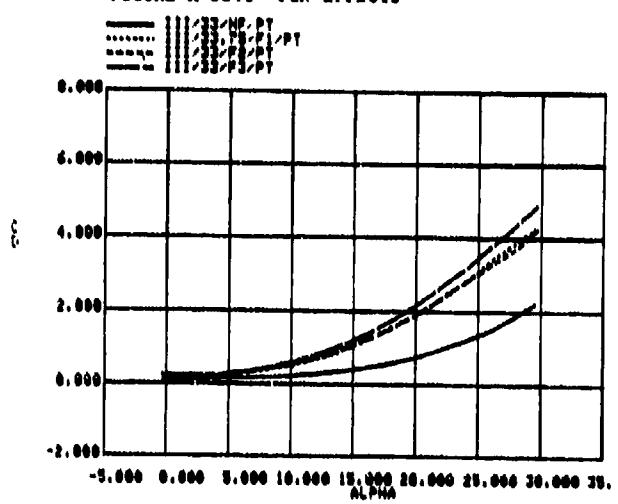


FIGURE A-30.2 FIN EFFECTS

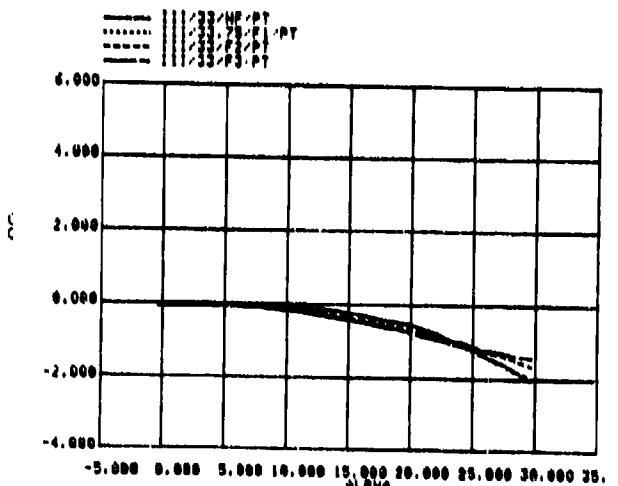


FIGURE A-30.3 FIN EFFECTS

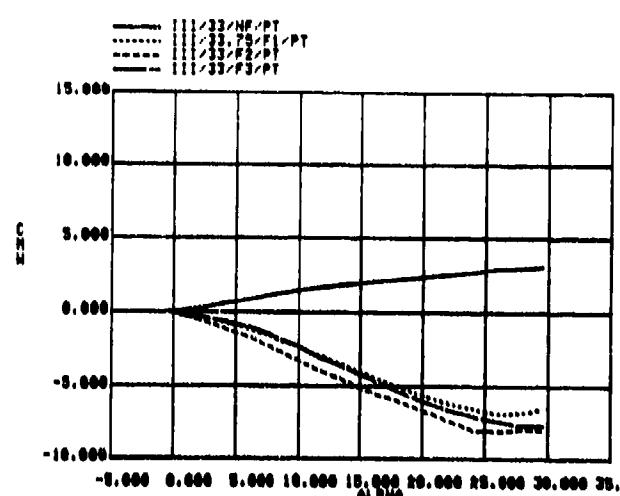


FIGURE A-30.4 FIN EFFECTS

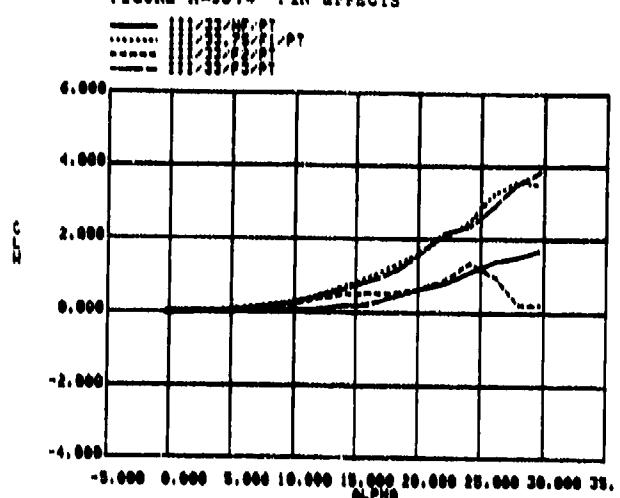


FIGURE A-30.5 FIN EFFECTS

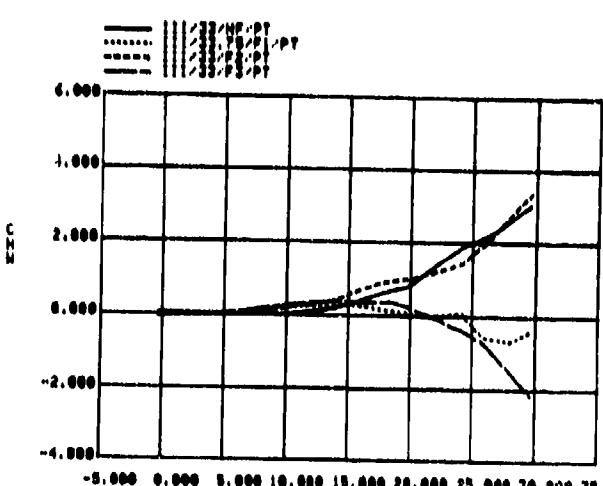


FIGURE A-30.6 FIN EFFECTS

FIGURE A-30. WIND AXIS FORCE & MOMENT FIN EFFECTS, MISSILE III,
ROLL 33, POINTED NOSE.

APPENDIX B

TABULAR LISTING OF FORCE & MOMENT COEFFICIENTS

The force and moment tests conducted on the missiles of fineness ratio 8 are briefly described at the beginning of Appendix A. A total of 66 tests were conducted. Printouts of the coefficient data are illustrated in Figures B.1 through B.66. Figures B.1 through B.40 illustrate body axis data while figures B.41 through B.66 illustrate wind axis data. Table B-1 defines the nomenclature used in Figures B.1 - B.66. Tables B-2 and B-3 describe the missile configurations tested in each of the 66 tests.

TABLE B-1

APPENDIX B NOMENCLATURE

CA	- Body Axis Axial Force Coefficient
CC	- Wind Axis Cross-Force Coefficient
CD	- Wind Axis Drag Coefficient
CL	- Wind Axis Lift Coefficient
CLW	- Wind Axis Rolling Moment Coefficient
CM	- Body Axis Pitching Moment Coefficient
CMW	- Wind Axis Pitching Moment Coefficient
CN	- Body Axis Normal Force Coefficient
CNW	- Wind Axis Yawing Moment Coefficient
CY	- Body Axis Side Force Coefficient
ROLCO	- Body Axis Rolling Moment Coefficient
YMC0	- Body Axis Yawing Moment Coefficient

TABLE B-2
FORCE - MOMENT TESTS
(DATA PRESENTED IN BODY AXIS SYSTEM FORMAT)

<u>Body*</u>	<u>Roll</u>	<u>Fin**</u>	<u>Nose***</u>	<u>Appendix Figure</u>
I	0°	NF	BL	B-1
I	22°	NF	BL	B-2
I	45°	NF	BL	B-3
II	0°	NF	BL	B-4
II	22°	NF	BL	B-5
II	45°	NF	BL	B-6
III	0°	NF	BL	B-7
III	22°	NF	BL	B-8
III	45°	NF	BL	B-9
IV	0°	NF	BL	B-10
III	0°	NF	PT	B-11
III	22°	NF	PT	B-12
III	45°	NF	PT	B-13
I	0°	F1	BL	B-14
I	22°	F1	BL	B-15
I	45°	F1	BL	B-16
II	0°	F1	BL	B-17
II	22°	F1	BL	B-18
II	45°	F1	BL	B-19
III	0°	F1	BL	B-20
III	22°	F1	BL	B-21
III	45°	F1	BL	B-22
IV	0°	F1	BL	B-23
IV	22°	F1	BL	B-24
IV	45°	F1	BL	B-25
III	0°	F1	PT	B-26
III	22°	F1	PT	B-27
III	45°	F1	PT	B-28

TABLE B-2
FORCE - MOMENT TESTS
(DATA PRESENTED IN BODY AXIS SYSTEM FORMAT)

<u>Body*</u>	<u>Roll</u>	<u>Fin**</u>	<u>Nose***</u>	<u>Appendix Figure</u>
III	0°	F2	BL	B-29
III	22°	F2	BL	B-30
III	45°	F2	BL	B-31
III	0°	F2	PT	B-32
III	22°	F2	PT	B-33
III	45°	F2	PT	B-34
III	0°	F3	BL	B-35
III	22°	F3	BL	B-36
III	45°	F3	BL	B-37
III	0°	F3	PT	B-38
III	22°	F3	PT	B-39
III	45°	F3	PT	B-40

***Body Configurations**

I - Square
II - 10% Corner Radius
III - 20% Corner Radius
IV - Round

****Fin Configurations**

NF - No Fins Attached
F1 - Fin #1
F2 - Fin #2
F3 - Fin #3

*****Nose Configurations**

BL - Blunt Nose
PT - Pointed Nose

TABLE B-3

FORCE - MOMENT TEST

(DATA PRESENTED IN WIND AXIS SYSTEM FORMAT)

<u>Body*</u>	<u>Roll</u>	<u>Fin**</u>	<u>Nose***</u>	<u>Appendix Figure</u>
I	11°	NF	BL	B-41
I	33°	NF	BL	B-42
II	11°	NF	BL	B-43
II	33°	NF	BL	B-44
III	11°	NF	BL	B-45
III	33°	NF	BL	B-46
III	11°	NF	PT	B-47
III	33°	NF	PT	B-48
I	11°	F1	BL	B-49
I	33°	F1	BL	B-50
II	11°	F1	BL	B-51
II	33°	F1	BL	B-52
III	11°	F1	BL	B-53
III	33°	F1	BL	B-54
IV	11°	F1	BL	B-55
IV	33°	F1	BL	B-56
III	11°	F1	PT	B-57
III	33°	F1	PT	B-58
III	11°	F2	BL	B-59
III	33°	F2	BL	B-60
III	11°	F2	PT	B-61
III	33°	F2	PT	B-62
III	11°	F3	BL	B-63
III	33°	F3	BL	B-64
III	11°	F3	PT	B-65
III	33°	F3	PT	B-66

*Body Configurations

I - Square
 II - 10% Corner Radius
 III - 20% Corner Radius
 IV - Round

**Fin Configurations

NF - No Fins Attached
 F1 - Fin #1
 F2 - Fin #2
 F3 - Fin #3

***Nose Configurations

BL - Blunt Nose
 PT - Pointed Nose

RUN NUMBER IS 7
 DATA TAKEN 13:03:59 06-MAR-60

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROL00
0.10	0.000	0.144	-0.006	-0.062	0.030	-0.011
2.25	0.136	0.147	-0.017	0.198	0.026	-0.014
4.25	0.296	0.147	-0.023	0.510	0.019	-0.019
5.76	0.429	0.143	-0.029	0.723	0.019	-0.019
8.20	0.690	0.149	-0.034	1.120	0.022	-0.026
10.23	1.238	0.143	-0.044	1.194	0.017	-0.029
12.27	2.023	0.142	-0.047	1.130	0.014	-0.033
14.27	2.381	0.120	-0.091	1.438	0.040	-0.037
15.71	2.621	0.086	-0.097	1.645	0.047	-0.039
18.17	3.006	0.070	-0.127	2.065	0.044	-0.038
20.15	3.310	0.000	-0.157	2.454	0.074	-0.038
22.27	3.645	-0.024	-0.206	2.944	0.113	-0.039
24.18	3.910	-0.034	-0.270	3.444	0.175	-0.033
26.26	4.277	-0.023	-0.342	3.944	0.228	-0.033
28.17	4.551	-0.151	-0.378	4.357	0.278	-0.030
30.00	4.696	-0.160	-0.453	4.702	0.350	-0.031

Figure B.1. Computer Tabulated Force and Moment Data for Missile I
 Zero Degrees Roll, No Fins, Blunt Nose

RUN NUMBER IS 8
 DATA TAKEN 13:22:13 06-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YNCO	ROLCO
-0.04	0.014	0.135	-0.018	-0.055	0.053	-0.010
2.31	0.162	0.142	-0.086	0.221	-0.053	-0.016
4.25	0.305	0.143	-0.181	0.485	-0.165	-0.017
6.12	0.454	0.143	-0.267	0.738	-0.260	-0.020
8.22	0.692	0.143	-0.421	1.055	-0.384	-0.016
10.28	0.965	0.129	-0.618	1.367	-0.475	-0.011
12.29	1.271	0.119	-0.820	1.704	-0.512	-0.001
14.27	1.571	0.107	-1.208	2.016	-0.497	0.011
16.17	1.860	0.082	-1.533	2.317	-0.430	0.015
18.15	2.110	0.064	-1.738	2.666	-0.307	0.020
19.77	2.418	0.040	-2.334	2.941	-0.170	0.018
22.24	2.873	0.018	-3.016	3.325	0.117	0.009
24.22	3.282	-0.015	-3.736	3.807	0.412	-0.013
26.24	3.663	-0.054	-4.488	4.233	0.671	-0.044
28.29	4.102	-0.116	-5.167	4.631	0.710	-0.074
30.00	4.501	-0.168	-5.886	4.974	0.638	-0.084

Figure B.2. Computer Tabulated Force and Moment Data for Missile I
 22° Roll, No Fins, Blunt Nose

RUN NUMBER IS 9
 DATA TAKEN 13133141 06-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROLCO
-0.19	0.032	0.130	-0.053	-0.036	0.071	-0.009
2.33	0.153	0.143	-0.160	0.182	-0.165	-0.014
4.33	0.256	0.148	-0.209	0.305	-0.348	-0.018
6.25	0.405	0.140	-0.454	0.587	-0.571	-0.022
8.25	0.619	0.126	-0.641	0.792	-0.775	-0.027
10.25	0.872	0.116	-0.920	1.010	-0.996	-0.035
12.25	1.235	0.097	-1.240	1.184	-1.191	-0.040
14.15	1.655	0.082	-1.594	1.320	-1.325	-0.046
16.25	1.985	0.062	-1.987	1.450	-1.465	-0.052
17.75	2.251	0.026	-2.267	1.549	-1.594	-0.055
20.13	2.814	-0.014	-2.808	1.739	-1.817	-0.059
22.25	3.350	-0.056	-3.340	1.910	-2.039	-0.064
24.19	3.914	-0.088	-3.888	2.155	-2.291	-0.066
26.25	4.543	-0.132	-4.473	2.418	-2.602	-0.069
28.25	5.092	-0.190	-5.011	2.698	-2.933	-0.070
30.00	5.671	-0.254	-5.555	3.006	-3.286	-0.066

Figure B.3. Computer Tabulated Force and Moment Data for Missile I
 45° Roll, No Fins, Blunt Nose

RUN NUMBER IS 1
 DATA TAKEN 09153147 06-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMCD	ROLCO
-0.01	-0.044	0.148	0.016	-0.125	0.007	-0.011
2.34	0.109	0.152	0.018	0.184	0.003	-0.015
4.40	0.247	0.152	0.009	0.477	0.002	-0.016
6.27	0.362	0.156	0.006	0.763	-0.006	-0.021
8.20	0.530	0.146	-0.015	1.029	0.001	-0.023
10.20	0.844	0.145	0.016	1.234	-0.039	-0.029
12.29	1.219	0.141	0.112	1.439	-0.116	-0.026
14.28	1.543	0.115	0.118	1.689	-0.148	-0.026
15.71	1.723	0.089	0.117	1.897	-0.153	-0.023
17.82	1.993	0.071	0.111	2.207	-0.157	-0.024
19.72	2.331	0.021	0.134	2.428	-0.181	-0.023
22.35	2.791	-0.023	0.100	2.708	-0.180	-0.027
24.23	3.184	-0.081	0.088	2.926	-0.186	-0.026
26.28	3.552	-0.105	0.061	3.229	-0.157	-0.019
28.20	3.891	-0.146	0.019	3.457	-0.144	-0.015
30.00	4.271	-0.204	0.007	3.734	-0.128	-0.006

Figure B.4. Computer Tabulated Force and Moment Data for Missile II
 0° Roll, No Fins, Blunt Nose

RUN NUMBER IS 2
 DATA TAKEN 10131139 06-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROLCO
0.03	-0.023	0.150	0.021	-0.092	0.058	-0.010
2.39	0.103	0.134	-0.023	0.191	-0.060	-0.015
4.27	0.205	0.144	-0.077	0.424	-0.149	-0.020
6.20	0.327	0.145	-0.153	0.682	-0.246	-0.024
8.21	0.491	0.150	-0.266	0.967	-0.341	-0.028
10.21	0.705	0.143	-0.428	1.256	-0.421	-0.028
12.30	0.941	0.132	-0.652	1.545	-0.442	-0.023
13.98	1.157	0.123	-0.874	1.811	-0.413	-0.024
16.29	1.426	0.106	-1.238	2.162	-0.306	-0.028
17.71	1.593	0.082	-1.472	2.364	-0.198	-0.029
19.76	1.840	0.062	-1.908	2.721	0.041	-0.040
22.37	2.241	0.041	-2.629	3.158	0.430	-0.060
24.24	2.538	0.014	-3.262	3.474	0.795	-0.084
26.37	2.870	-0.019	-4.011	3.843	1.110	-0.112
27.76	3.147	-0.047	-4.537	4.087	1.297	-0.129
30.00	3.410	-0.111	-5.299	4.377	1.363	-0.150

Figure B.5. Computer Tabulated Force and Moment Data for Missile II
 22° Roll, No Fins, Blunt Nose

RUN NUMBER IS 3
 DATA TAKEN 1014912 06-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROLCO
-0.28	0.284	0.149	0.169	-0.320	-0.088	-0.008
2.35	0.368	0.148	0.094	-0.093	-0.310	-0.010
4.33	0.432	0.150	-0.027	0.129	-0.508	-0.015
5.94	0.544	0.138	-0.120	0.258	-0.638	-0.017
8.28	0.707	0.132	-0.314	0.493	-0.861	-0.025
10.24	0.920	0.132	-0.508	0.673	-1.038	-0.030
12.29	1.143	0.124	-0.724	0.896	-1.212	-0.036
14.15	1.432	0.115	-1.132	1.026	-1.286	-0.044
15.74	1.654	0.100	-1.401	1.120	-1.352	-0.049
17.70	2.000	0.079	-1.737	1.228	-1.446	-0.056
19.73	2.394	0.025	-2.132	1.332	-1.523	-0.055
22.28	2.968	-0.015	-2.782	1.472	-1.610	-0.054
24.22	3.441	-0.061	-3.317	1.693	-1.758	-0.055
26.28	3.913	-0.098	-3.919	1.981	-1.919	-0.062
28.29	4.380	-0.154	-4.462	2.292	-2.140	-0.060
30.00	4.875	-0.201	-4.982	2.648	-2.101	-0.059

FIGURE B.6. Computer Tabulated Force and Moment Data for Missile II
 45° Roll, No Fins, Blunt Nose

RUN NUMBER IS 4
 DATA TAKEN 11:27:47 06-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMCN	ROLCO
-0.10	0.001	0.143	0.004	-0.107	0.013	-0.007
2.13	0.151	0.144	-0.002	0.190	0.019	-0.011
4.30	0.265	0.143	-0.017	0.468	0.024	-0.014
6.35	0.377	0.139	-0.033	0.751	0.030	-0.018
8.17	0.522	0.140	-0.033	1.032	0.031	-0.020
10.27	0.683	0.143	-0.030	1.306	0.041	-0.025
12.16	0.849	0.135	-0.033	1.577	0.043	-0.029
13.94	1.027	0.123	-0.041	1.835	0.050	-0.032
16.05	1.209	0.104	-0.045	2.102	0.062	-0.034
17.87	1.357	0.081	-0.044	2.352	0.065	-0.037
19.71	1.536	0.060	-0.056	2.630	0.080	-0.041
22.28	1.729	0.030	-0.051	3.050	0.077	-0.047
24.24	2.008	0.004	-0.061	3.388	0.105	-0.049
26.27	2.214	-0.028	-0.021	3.696	0.071	-0.055
28.19	2.431	-0.059	-0.032	3.970	0.074	-0.057
30.00	2.640	-0.091	-0.056	4.249	0.122	-0.058

Figure B.7. Computer Tabulated Force and Moment Data for Missile III
 0° Roll, No Fins, Blunt Nose

RUN NUMBER IS 5
 DATA TAKEN 11:41:16 06-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROLCO
-0.01	0.138	0.123	-0.062	-0.019	0.031	-0.002
2.45	0.289	0.140	-0.124	0.270	-0.007	-0.007
4.38	0.360	0.139	-0.167	0.522	-0.179	-0.010
6.32	0.417	0.135	-0.220	0.752	-0.263	-0.015
8.26	0.558	0.139	-0.270	1.006	-0.352	-0.020
9.90	0.648	0.134	-0.337	1.211	-0.416	-0.027
12.30	0.878	0.131	-0.474	1.499	-0.489	-0.032
13.71	0.995	0.118	-0.572	1.671	-0.482	-0.036
16.30	1.211	0.091	-0.793	1.956	-0.443	-0.043
17.74	1.324	0.070	-0.933	2.126	-0.388	-0.046
19.90	1.500	0.060	-1.106	2.424	-0.249	-0.054
22.25	1.717	0.037	-1.527	2.804	-0.021	-0.064
24.23	1.866	0.010	-1.963	3.196	0.335	-0.074
26.26	2.039	-0.005	-2.480	3.523	0.824	-0.086
28.28	2.260	-0.041	-2.987	3.756	1.297	-0.104
30.00	2.470	-0.079	-3.195	3.987	1.677	-0.117

Figure B.8. Computer Tabulated Force and Moment Data for Missile III
 22° Roll, No Fins, Blunt Nose

RUN NUMBER IS 6
 DATA TAKEN 11:58:56 06-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROLCO
-0.17	0.142	0.132	-0.072	-0.020	0.059	-0.002
2.87	0.229	0.136	-0.176	0.198	-0.155	-0.007
4.35	0.285	0.132	-0.253	0.374	-0.342	-0.010
6.26	0.367	0.132	-0.341	0.559	-0.529	-0.014
8.28	0.470	0.128	-0.451	0.728	-0.712	-0.018
10.27	0.595	0.130	-0.568	0.886	-0.876	-0.022
12.08	0.735	0.127	-0.737	1.025	-1.015	-0.028
13.73	0.868	0.120	-0.903	1.143	-1.104	-0.034
15.72	1.034	0.096	-1.110	1.207	-1.143	-0.037
17.72	1.218	0.075	-1.312	1.237	-1.166	-0.037
19.73	1.494	0.048	-1.663	1.281	-1.148	-0.041
22.23	1.889	0.011	-2.155	1.295	-1.072	-0.040
24.18	2.255	-0.013	-2.599	1.381	-1.076	-0.063
26.23	2.650	-0.048	-3.110	1.654	-1.174	-0.088
28.29	3.047	-0.110	-3.592	1.926	-1.361	-0.121
30.00	3.515	-0.144	-3.745	2.085	-1.684	-0.130

Figure B.9. Computer Tabulated Force and Moment Data for Missile III
 45° Roll, No Fins, Blunt Nose

RUN NUMBER IS 12
 DATA TAKEN 14114159 06-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROL CO
-0.06	0.017	0.089	-0.007	-0.098	-0.014	-0.008
2.21	0.078	0.094	-0.011	0.122	0.004	-0.009
4.36	0.192	0.092	-0.016	0.344	0.007	-0.012
6.50	0.264	0.087	-0.028	0.376	0.007	-0.015
8.65	0.362	0.092	-0.032	0.803	0.012	-0.019
10.79	0.464	0.074	-0.029	1.022	0.011	-0.021
12.93	0.563	0.090	-0.043	1.265	0.019	-0.023
13.76	0.668	0.085	-0.049	1.381	0.029	-0.027
15.79	0.795	0.075	-0.068	1.573	0.045	-0.029
17.72	0.916	0.060	-0.072	1.713	0.046	-0.031
19.76	1.040	0.043	-0.062	1.830	0.023	-0.036
22.79	1.324	0.025	-0.057	1.973	0.017	-0.038
24.23	1.618	0.003	-0.003	2.115	-0.052	-0.042
26.22	1.724	-0.020	0.017	2.283	-0.067	-0.044
28.21	2.195	-0.053	0.004	2.492	-0.064	-0.048
30.00	3.070	-0.506	-0.056	3.373	-0.094	-0.079

Figure B.10. Computer Tabulated Force and Moment Data for Missile IV
 0° Roll No Fins, Blunt Nose

MISSILE III, ROLL 0, NO FINS, POINTED NO - III/0/NF/PT

RUN NUMBER IS 16
 DATA TAKEN 16:02:37 06-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROLCO
-0.12	0.029	0.122	0.000	-0.097	0.018	-0.006
2.20	0.154	0.123	-0.014	0.214	0.016	-0.010
4.40	0.273	0.119	-0.023	0.304	0.019	-0.013
6.27	0.388	0.113	-0.032	0.788	0.020	-0.016
8.27	0.540	0.116	-0.023	1.090	0.021	-0.020
10.27	0.685	0.112	-0.028	1.402	0.019	-0.024
12.27	0.856	0.101	-0.034	1.699	0.017	-0.027
14.27	1.051	0.099	-0.039	2.000	0.031	-0.033
16.28	1.242	0.085	-0.042	2.303	0.030	-0.034
17.74	1.378	0.066	-0.018	2.491	0.018	-0.037
19.84	1.502	0.043	-0.035	2.859	0.030	-0.042
22.24	1.681	0.017	0.013	3.263	-0.001	-0.047
24.21	2.095	-0.009	0.060	3.604	-0.029	-0.050
26.22	2.332	-0.037	-0.033	3.760	0.050	-0.054
28.29	2.583	-0.077	-0.087	4.270	0.131	-0.058
30.00	2.780	-0.104	-0.154	4.560	0.220	-0.059

Figure B.11. Computer Tabulated Force and Moment Data for Missile III
 0° Roll, No Fins, Pointed Nose

MISSILE III, ROLL 22.5, NO FINS, POINTED - III/22.5/NF/PT

RUN NUMBER IS 17
DATA TAKEN 16111141 06-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMD0	RDI00
0.22	0.126	0.117	-0.053	0.007	0.012	-0.006
2.22	0.232	0.127	-0.115	0.262	-0.091	-0.009
4.34	0.321	0.122	-0.164	0.537	-0.194	-0.013
6.33	0.419	0.109	-0.207	0.786	-0.290	-0.017
8.30	0.562	0.103	-0.273	1.060	-0.396	-0.021
10.26	0.703	0.108	-0.343	1.325	-0.491	-0.028
12.29	0.828	0.102	-0.420	1.596	-0.591	-0.034
13.81	1.007	0.078	-0.596	1.807	-0.584	-0.035
16.09	1.222	0.078	-0.790	2.049	-0.553	-0.034
17.72	1.384	0.061	-0.956	2.250	-0.492	-0.031
20.25	1.602	0.041	-1.200	2.730	-0.364	-0.062
22.24	1.812	0.029	-1.677	3.103	-0.078	-0.085
24.18	2.094	0.015	-1.969	3.354	0.070	-0.101
26.22	2.360	-0.016	-2.110	3.728	0.305	-0.122
28.29	2.681	-0.054	-2.763	4.026	0.509	-0.131
30.00	3.047	-0.104	-3.185	4.246	1.052	-0.159

Figure B.12. Computer Tabulated Force and Moment Data for Missile III
22° Roll, No Fins, Pointed Nose

RUN NUMBER IS 20
 DATA TAKEN 16126141 06-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CH	YMD0	ROL00
-0.26	0.084	0.142	-0.087	0.003	0.029	-0.005
2.34	0.173	0.141	-0.175	0.213	-0.106	-0.009
3.80	0.239	0.143	-0.262	0.359	-0.330	-0.012
6.33	0.320	0.133	-0.363	0.618	-0.584	-0.017
8.29	0.432	0.133	-0.484	0.814	-0.776	-0.022
10.27	0.540	0.130	-0.606	1.001	-0.757	-0.029
12.20	0.737	0.126	-0.793	1.155	-1.117	-0.038
14.26	0.711	0.110	-1.000	1.292	-1.239	-0.045
16.28	1.173	0.089	-1.269	1.406	-1.317	-0.050
17.75	1.352	0.068	-1.462	1.474	-1.365	-0.053
20.29	1.755	0.046	-1.909	1.601	-1.452	-0.056
22.23	2.126	0.023	-2.213	1.725	-1.630	-0.051
24.17	2.518	0.000	-2.576	1.850	-1.915	-0.050
26.21	2.968	-0.029	-3.013	2.096	-2.125	-0.052
28.27	3.377	-0.077	-3.485	2.391	-2.340	-0.043
30.00	3.811	-0.132	-3.932	2.720	-2.680	-0.066

Figure B.13. Computer Tabulated Force and Moment Data for Missile III
 45° Roll, No Fins, Pointed Nose

RUN NUMBER IS 27
 DATA TAKEN 15:36:12 07-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROL CO
-0.14	-0.054	0.261	0.025	0.061	-0.016	-0.010
2.21	0.188	0.243	-0.107	-0.070	0.105	-0.011
4.36	0.432	0.237	-0.235	-0.212	0.233	-0.018
6.53	0.706	0.232	-0.336	-0.373	0.338	-0.023
8.16	1.165	0.220	-0.367	-0.677	0.334	-0.023
10.30	1.800	0.201	-0.377	-1.128	0.333	-0.024
12.23	2.465	0.182	-0.383	-1.637	0.338	-0.024
14.28	3.116	0.143	-0.389	-2.113	0.321	-0.018
16.19	3.685	0.109	-0.422	-2.529	0.328	-0.019
18.01	4.313	0.069	-0.436	-2.954	0.313	-0.002
19.91	4.910	0.021	-0.443	-3.414	0.300	0.011
22.26	5.720	-0.034	-0.487	-4.002	0.294	0.030
24.21	6.470	-0.072	-0.524	-4.445	0.291	0.062
26.26	7.195	-0.121	-0.551	-4.880	0.264	0.100
28.23	7.763	-0.151	-0.649	-5.023	0.331	0.162
30.00	8.196	-0.175	-0.598	-4.880	0.217	0.143

Figure B.14. Computer Tabulated Force and Moment Data for Missile I
 0° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 30
 DATA TAKEN 15148152 07-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	R01CO
0.44	-0.358	0.247	-0.036	0.564	-0.051	-0.006
2.40	-0.070	0.232	-0.195	0.328	0.092	-0.009
4.25	0.300	0.235	-0.401	0.036	0.234	-0.014
6.35	0.674	0.221	-0.606	-0.234	0.397	-0.011
8.26	1.208	0.212	-0.781	-0.645	0.492	-0.006
10.26	1.620	0.196	-1.217	-0.914	0.868	0.014
12.23	2.272	0.177	-1.644	-1.352	1.112	0.049
13.73	2.716	0.157	-1.937	-1.648	1.300	0.081
16.34	3.529	0.118	-2.499	-2.203	1.630	0.165
17.77	3.982	0.101	-2.811	-2.305	1.808	0.234
19.77	4.627	0.056	-3.369	-2.874	2.053	0.362
22.25	5.509	0.019	-4.120	-3.302	2.318	0.526
24.21	6.164	-0.026	-4.811	-3.630	2.593	0.668
26.26	6.868	-0.076	-5.666	-3.799	2.874	0.774
27.75	7.381	-0.104	-6.233	-3.873	2.970	0.792
30.00	7.906	-0.117	-7.161	-3.369	2.928	0.581

Figure B.15. Computer Tabulated Force and Moment Data for Missile I
 22° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 31
 DATA TAKEN 14:00:03 07-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROLCO
-0.08	-0.642	0.258	0.087	0.790	-0.283	-0.010
2.87	-0.302	0.253	-0.210	0.514	-0.006	-0.015
4.35	-0.005	0.238	-0.525	0.262	0.244	-0.023
6.27	0.364	0.231	-0.887	-0.004	0.521	-0.030
8.22	0.759	0.203	-1.207	-0.311	0.760	-0.039
10.27	1.250	0.192	-1.791	-0.663	1.167	-0.039
12.24	1.822	0.174	-2.364	-1.013	1.544	-0.052
13.72	2.234	0.153	-2.700	-1.273	1.802	-0.060
16.27	2.950	0.126	-3.500	-1.713	2.222	-0.084
17.71	3.368	0.098	-3.927	-1.937	2.414	-0.102
20.27	4.292	0.052	-4.634	-2.413	2.930	-0.114
22.26	4.794	0.012	-5.547	-2.710	3.207	-0.127
24.21	5.773	-0.020	-6.302	-2.945	3.422	-0.132
26.25	6.555	-0.082	-7.123	-3.056	3.517	-0.130
28.29	7.314	-0.142	-7.854	-3.144	3.602	-0.126
30.00	8.038	-0.209	-8.557	-3.210	3.607	-0.122

Figure B.16. Computer Tabulated Force and Moment Data for Missile I
 45° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 21
 DATA TAKEN 13:13:29 07-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROLCO
-0.03	-0.085	0.729	0.004	0.081	0.004	-0.022
2.28	0.174	0.230	-0.135	-0.093	0.132	-0.027
4.31	0.403	0.212	-0.251	-0.284	0.244	-0.032
6.20	0.628	0.203	-0.358	-0.525	0.339	-0.039
8.09	1.121	0.192	-0.359	-0.962	0.326	-0.038
10.11	1.669	0.173	-0.358	-1.184	0.322	-0.031
12.22	2.292	0.150	-0.411	-2.087	0.287	-0.014
13.72	2.724	0.131	-0.437	-2.461	0.290	-0.005
16.21	3.394	0.089	-0.454	-3.108	0.294	0.024
18.03	3.931	0.036	-0.489	-3.586	0.281	0.041
20.29	4.639	0.014	-0.506	-4.182	0.216	0.055
22.26	5.269	-0.017	-0.525	-4.715	0.239	0.078
24.24	5.892	-0.052	-0.583	-5.155	0.274	0.114
26.27	6.428	-0.078	-0.635	-5.401	0.214	0.167
28.01	6.821	-0.110	-0.651	-5.417	0.109	0.194
30.00	7.270	-0.138	-0.682	-5.217	0.103	0.224

Figure 17. Computer Tabulated Force and Moment Data for Missile II
 0° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 22
 DATA TAKEN 13137180 07-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROL CO
-0.31	-0.121	0.258	0.071	0.086	-0.041	-0.017
2.37	0.307	0.248	-0.116	-0.258	0.116	-0.022
4.24	0.674	0.238	-0.285	-0.572	0.270	-0.029
6.17	1.035	0.223	-0.471	-0.913	0.459	-0.033
8.21	1.409	0.210	-0.607	-1.320	0.620	-0.030
10.21	1.982	0.190	-0.789	-1.830	0.961	-0.016
12.30	2.551	0.168	-1.357	-2.354	1.287	0.015
14.19	3.081	0.145	-1.670	-2.841	1.519	0.047
15.88	3.530	0.118	-2.004	-3.228	1.784	0.131
17.96	4.056	0.083	-2.403	-3.685	2.016	0.230
19.76	4.614	0.054	-2.796	-4.110	2.270	0.345
22.27	5.332	0.015	-3.102	-4.543	2.572	0.518
24.23	6.971	-0.018	-3.962	-4.889	2.664	0.635
26.28	6.466	-0.064	-4.578	-4.961	2.666	0.684
28.08	6.800	-0.129	-5.089	-4.962	2.661	0.724
30.00	7.146	-0.144	-5.608	-4.642	2.332	0.566

Figure B.18. Computer Tabulated Force and Moment Data for Missile II
 22° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 23
 DATA TAKEN 13157108 07-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROLCO
0.29	-0.016	0.271	0.040	0.002	0.016	-0.021
2.34	0.239	0.256	-0.223	-0.213	0.234	-0.024
4.46	0.523	0.241	-0.504	-0.485	0.501	-0.034
6.37	0.846	0.231	-0.831	-0.807	0.810	-0.040
8.28	1.154	0.219	-0.919	-1.103	0.921	-0.044
10.29	1.398	0.205	-1.123	-1.559	1.117	-0.048
12.19	2.063	0.184	-1.345	-1.946	1.268	-0.055
14.22	2.805	0.161	-1.598	-2.310	1.416	-0.060
15.81	2.898	0.130	-1.782	-2.551	1.482	-0.073
17.78	3.359	0.046	-2.032	-2.848	1.564	-0.072
20.24	4.061	-0.041	-2.425	-3.236	1.662	-0.098
22.26	4.684	-0.133	-2.808	-3.539	1.709	-0.112
24.23	5.422	-0.198	-3.276	-3.842	1.736	-0.109
26.24	6.104	-0.244	-3.687	-4.065	1.700	-0.128
27.88	6.560	-0.248	-3.967	-4.132	1.617	-0.135
30.00	7.303	-0.419	-4.419	-4.195	1.385	-0.142

Figure B.19. Computer Tabulated Force and Moment Data for Missile II
 45° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 24
 DATA TAKEN 14:31:33 07-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROL00
0.50	0.028	0.242	-0.002	-0.007	0.007	-0.014
2.28	0.361	0.236	-0.013	-0.291	0.011	-0.017
4.39	0.705	0.214	-0.003	-0.606	0.018	-0.024
5.88	1.035	0.206	-0.020	-0.879	0.027	-0.026
8.27	1.551	0.185	-0.009	-1.454	0.033	-0.027
10.24	2.046	0.171	-0.024	-2.033	0.042	-0.030
12.31	2.644	0.153	-0.037	-2.696	0.044	-0.035
13.69	3.011	0.133	-0.050	-3.107	0.052	-0.031
16.23	3.643	0.094	-0.075	-3.821	0.098	-0.037
18.09	4.112	0.056	-0.076	-4.358	0.086	-0.044
20.14	4.711	0.019	-0.073	-4.992	0.072	-0.041
22.23	5.305	-0.023	-0.103	-5.649	0.095	-0.040
24.23	5.902	-0.060	-0.095	-6.279	0.087	-0.037
26.29	6.462	-0.096	-0.082	-6.859	0.102	-0.049
28.29	6.935	-0.120	-0.092	-7.169	0.089	-0.047
30.00	7.180	-0.111	-0.107	-6.931	0.071	-0.019

Figure B.20. Computer Tabulated Force and Moment Data for Missile III
 0° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 25
 DATA TAKEN 14144134 07-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROLCO
-0.16	0.047	0.251	-0.011	0.133	-0.054	-0.007
2.06	0.386	0.248	-0.158	-0.177	0.069	-0.011
4.32	0.771	0.234	-0.322	-0.524	0.237	-0.021
6.44	1.156	0.217	-0.493	-0.910	0.438	-0.027
8.29	1.534	0.202	-0.676	-1.311	0.671	-0.031
10.10	1.939	0.187	-0.912	-1.801	0.975	-0.036
11.96	2.425	0.166	-1.179	-2.367	1.320	-0.040
13.73	2.860	0.140	-1.452	-2.904	1.650	-0.020
15.71	3.331	0.106	-1.718	-3.450	1.937	-0.002
18.13	3.930	0.071	-2.086	-4.156	2.328	0.044
20.23	4.510	0.028	-2.442	-4.725	2.674	0.085
22.27	5.067	0.010	-2.851	-5.227	3.023	0.149
24.22	5.501	-0.001	-3.243	-5.472	3.191	0.192
26.26	5.916	0.000	-3.664	-5.562	3.182	0.149
27.90	6.286	-0.032	-3.838	-5.714	3.276	0.112
30.00	6.725	-0.019	-4.172	-5.706	3.617	0.071

Figure B.21. Computer Tabulated Force and Moment Data for Missile III
 22° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 26
 DATA TAKEN 14157104 07-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMCD	ROLCO
0.01	0.049	0.250	-0.047	0.102	-0.126	-0.006
2.27	0.353	0.244	-0.336	-0.146	0.127	-0.013
4.41	0.606	0.238	-0.608	-0.395	0.390	-0.021
6.57	0.891	0.222	-0.890	-0.693	0.694	-0.024
8.73	1.212	0.215	-1.233	-1.053	1.086	-0.028
9.79	1.506	0.205	-1.532	-1.432	1.446	-0.031
12.00	1.996	0.187	-2.017	-2.075	2.089	-0.034
13.75	2.386	0.160	-2.451	-2.580	2.599	-0.029
16.29	2.906	0.117	-3.020	-3.271	3.307	-0.013
18.10	3.343	0.077	-3.466	-3.718	3.796	-0.009
20.79	3.877	0.074	-4.024	-4.343	4.346	0.003
22.23	4.418	0.054	-4.584	-4.906	4.883	0.009
24.21	4.989	0.038	-5.152	-5.409	5.298	0.023
26.26	5.570	-0.004	-5.746	-5.729	5.831	0.038
28.29	6.228	-0.053	-6.670	-6.845	6.218	-0.006
30.00	6.891	-0.007	-7.293	-6.096	6.130	-0.041

Figure B.22. Computer Tabulated Force and Moment Data for Missile III
 45° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 32
 DATA TAKEN 09:33:02 10-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROL CO
-0.04	-0.080	0.203	-0.005	0.031	0.006	-0.011
2.22	0.278	0.202	0.004	-0.292	0.002	-0.014
4.30	0.571	0.189	0.008	-0.621	0.007	-0.017
6.44	0.874	0.173	-0.003	-1.070	0.008	-0.020
8.35	1.233	0.158	-0.006	-1.478	0.012	-0.021
10.27	1.697	0.150	-0.014	-2.034	0.025	-0.024
12.26	2.131	0.129	-0.024	-2.664	0.052	-0.027
13.95	2.530	0.114	-0.048	-3.227	0.088	-0.027
16.33	3.059	0.087	-0.049	-4.028	0.103	-0.019
17.75	3.380	0.061	-0.034	-4.465	0.055	-0.032
19.76	3.825	0.033	-0.043	-5.083	0.074	-0.028
22.28	4.467	0.006	-0.066	-5.976	0.060	-0.003
24.25	5.001	-0.018	-0.081	-6.668	0.057	0.018
26.06	5.162	-0.030	-0.088	-7.149	0.041	0.052
27.76	5.835	-0.055	-0.160	-7.422	0.063	0.087
30.00	6.252	-0.084	-0.130	-7.438	-0.036	0.101

Figure B.23. Computer Tabulated Force and Moment Data for Missile IV
 0° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 33
 DATA TAKEN 09:44:28 10-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROLCO
-0.22	0.037	0.100	-0.011	0.138	-0.066	-0.006
2.25	0.347	0.106	-0.132	-0.218	0.080	-0.010
4.31	0.659	0.109	-0.281	-0.450	0.219	-0.016
6.30	0.958	0.102	-0.422	-0.856	0.405	-0.019
8.29	1.263	0.100	-0.565	-1.316	0.616	-0.023
10.27	1.667	0.127	-0.773	-1.848	0.965	-0.024
12.30	2.146	0.111	-1.026	-2.464	1.293	-0.033
13.00	2.441	0.091	-1.181	-2.758	1.563	-0.051
15.00	2.826	0.066	-1.380	-3.505	1.893	-0.071
16.35	3.367	0.028	-1.667	-4.310	2.352	-0.087
20.26	3.842	0.002	-1.924	-4.976	2.717	-0.088
22.23	4.328	-0.017	-2.187	-5.634	3.076	-0.077
24.21	4.780	-0.034	-2.427	-6.174	3.429	-0.105
26.26	5.071	-0.003	-2.402	-6.070	3.286	-0.153
28.08	5.473	-0.035	-2.600	-6.482	3.547	-0.549
30.00	5.936	-0.077	-2.794	-6.808	3.781	-0.624

Figure No. B.24. Computer Tabulated Force and Moment Data for Missile IV
 22° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS . 34
 DATA TAKEN 09153144 10-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMCD	ROLCO
-0.23	0.057	0.192	-0.037	0.000	0.131	-0.011
2.35	0.300	0.183	-0.280	-0.158	0.120	-0.013
4.13	0.503	0.174	-0.488	-0.358	0.330	-0.020
6.26	0.777	0.164	-0.764	-0.692	0.671	-0.027
8.22	1.023	0.151	-1.017	-1.032	1.020	-0.030
10.25	1.344	0.139	-1.358	-1.505	1.470	-0.032
12.01	1.686	0.124	-1.686	-1.966	1.964	-0.047
13.76	2.037	0.104	-2.031	-2.557	2.518	-0.051
15.75	2.363	0.075	-2.366	-3.077	3.026	-0.044
18.35	2.806	0.042	-2.816	-3.731	3.627	-0.030
20.23	3.143	0.018	-3.191	-4.211	4.207	-0.026
22.25	3.552	-0.005	-3.451	-4.771	4.827	-0.018
24.23	3.898	-0.018	-4.033	-5.222	5.322	-0.007
24.26	4.259	-0.030	-4.413	-5.616	5.713	0.002
27.98	4.498	-0.036	-4.695	-5.711	5.813	-0.066
30.00	4.767	-0.045	-5.003	-5.734	5.919	-0.094

Figure No. B.25. Computer Tabulated Force and Moment Data for Missile IV
 45° Roll, Fin No. 1, Blunt Nose

MISSILE III, ROLL 0, FIN 1, POINTED NOSE - III/0/F1/PT

RUN NUMBER IS 40
 DATA TAKEN 11110341 10-MAR-60

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CH	YMCO	ROLCO
-0.05	-0.054	0.226	-0.016	0.084	0.027	-0.009
2.32	0.374	0.218	-0.017	-0.268	0.025	-0.017
4.31	0.775	0.207	-0.031	-0.600	0.040	-0.024
6.07	1.127	0.195	-0.024	-0.947	0.035	-0.026
8.32	1.637	0.176	-0.035	-1.479	0.033	-0.031
10.29	2.154	0.158	-0.030	-2.018	0.031	-0.037
12.28	2.722	0.143	-0.033	-2.638	0.043	-0.046
13.74	3.114	0.128	-0.041	-3.040	0.068	-0.034
15.74	3.621	0.092	-0.062	-3.573	0.083	-0.058
17.77	4.158	0.054	-0.057	-4.113	0.111	-0.072
19.73	4.668	0.021	-0.057	-4.648	0.194	-0.097
22.26	5.391	-0.027	-0.040	-5.374	0.216	-0.144
24.20	5.984	-0.070	-0.031	-5.941	0.293	-0.191
26.23	6.565	-0.106	-0.061	-6.482	0.235	-0.167
27.71	6.929	-0.124	-0.081	-6.643	0.226	-0.147
30.00	7.268	-0.119	-0.116	-4.297	0.171	-0.088

Figure B.26. Computer Tabulated Force and Moment Data for Missile III
 0° Roll, Fin No. 1, Pointed Nose

RUN NUMBER IS 41
 DATA TAKEN 11:18:02 10-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YNCO	ROLCO
-0.16	0.101	0.210	-0.017	0.138	-0.040	0.000
2.17	0.180	0.212	-0.204	-0.170	0.092	-0.007
4.36	0.835	0.193	-0.365	-0.497	0.254	-0.015
6.37	1.184	0.175	-0.532	-0.655	0.438	-0.024
7.86	1.473	0.162	-0.692	-1.180	0.633	-0.025
10.22	2.052	0.147	-0.908	-1.805	0.926	-0.040
12.00	2.480	0.131	-1.262	-2.301	1.329	-0.049
14.20	3.028	0.097	-1.504	-2.871	1.697	-0.036
16.29	3.544	0.066	-1.805	-3.388	2.007	-0.022
17.99	3.940	0.039	-2.170	-3.792	2.267	0.006
19.80	4.420	0.016	-2.474	-4.285	2.563	0.064
22.24	5.113	-0.019	-2.788	-4.787	2.910	0.162
24.18	5.657	-0.046	-3.112	-5.041	3.329	0.154
26.23	6.014	-0.043	-3.293	-4.938	3.462	0.078
28.29	6.511	-0.071	-4.076	-4.937	3.597	-0.037
30.00	6.881	-0.075	-4.545	-4.873	3.887	-0.077

Figure B.27. Computer Tabulated Force and Moment Data for Missile III
 22° Roll, Fin No. 1, Pointed Nose

RUN NUMBER IS 42
 DATA TAKEN 11:27:17 10-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CD	CY	CM	YMCD	RDICD
-0.08	0.047	0.206	-0.067	0.141	-0.124	0.000
2.32	0.365	0.207	-0.370	-0.133	0.140	-0.007
4.54	0.658	0.189	-0.679	-0.412	0.425	-0.012
6.76	0.931	0.181	-0.750	-0.474	0.702	-0.018
8.98	1.222	0.164	-1.257	-1.036	1.079	-0.024
10.20	1.630	0.145	-1.678	-1.530	1.571	-0.030
12.29	2.079	0.128	-2.152	-2.033	2.110	-0.037
13.96	2.467	0.113	-2.571	-2.443	2.508	-0.033
16.30	3.043	0.079	-3.165	-3.003	3.137	-0.039
18.30	3.516	0.077	-3.687	-3.388	3.500	-0.037
19.77	3.920	0.054	-4.067	-3.709	3.873	-0.043
22.24	4.609	0.028	-4.802	-4.302	4.511	-0.061
24.18	5.238	-0.013	-5.460	-4.599	4.825	-0.088
26.23	5.889	-0.035	-6.182	-4.909	5.215	-0.081
27.79	6.342	-0.060	-6.713	-5.075	5.403	-0.081
30.00	7.133	-0.107	-7.515	-5.251	5.510	-0.080

Figure B.28. Computer Tabulated Force and Moment Data for Missile III
 45° Roll, Fin No. 1, Pointed Nose

RUN NUMBER IS 43
 DATA TAKEN 13:35:32 10-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	R01C0
-0.09	-0.114	0.272	0.001	0.096	0.012	-0.015
2.12	0.358	0.278	0.002	-0.458	0.022	-0.019
4.28	0.776	0.257	-0.002	-0.980	0.017	-0.022
6.32	1.301	0.238	-0.014	-1.536	0.033	-0.025
8.28	1.711	0.225	-0.012	-2.186	0.050	-0.029
10.25	2.248	0.205	-0.013	-2.732	0.065	-0.041
12.30	2.809	0.178	-0.019	-3.661	0.095	-0.042
13.73	3.195	0.155	-0.062	-4.131	0.071	-0.038
15.84	3.719	0.109	-0.067	-4.725	0.085	-0.033
18.01	4.252	0.057	-0.054	-5.445	0.070	-0.038
20.15	4.779	0.023	-0.077	-6.038	0.112	-0.046
22.25	5.317	-0.018	-0.089	-6.564	0.124	-0.045
24.20	5.812	-0.061	-0.085	-7.068	0.144	-0.052
26.26	6.341	-0.102	-0.127	-7.514	0.184	-0.057
28.08	6.671	-0.125	-0.118	-7.744	0.190	-0.093
30.00	7.095	-0.144	-0.100	-7.875	0.018	-0.134

Figure B.29. Computer Tabulated Force and Moment Data for Missile III
 0° Roll, Fin No. 2, Blunt Nose

RUN NUMBER IS 44
 DATA TAKEN 13:48:13 10-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CH	YMC0	ROLCO
-0.10	-0.040	0.266	0.038	0.115	-0.065	-0.008
2.38	0.109	0.265	-0.151	-0.419	0.162	-0.013
4.36	0.783	0.253	-0.309	-0.897	0.388	-0.018
6.33	1.111	0.233	-0.487	-1.376	0.631	-0.026
8.24	1.604	0.214	-0.720	-1.980	0.972	-0.030
10.28	2.107	0.185	-0.997	-2.680	1.388	-0.042
11.88	2.503	0.167	-1.212	-3.211	1.686	-0.043
14.27	3.080	0.136	-1.550	-3.754	2.118	-0.034
16.33	3.561	0.100	-1.828	-4.337	2.413	-0.037
18.37	4.027	0.071	-2.178	-5.068	2.903	-0.055
20.08	4.407	0.030	-2.406	-5.433	3.160	-0.100
22.25	4.887	0.010	-2.650	-5.709	3.392	-0.202
24.18	5.369	-0.030	-2.910	-6.356	3.401	-0.249
26.27	5.914	-0.074	-3.234	-6.871	3.450	-0.268
28.30	6.350	-0.077	-3.590	-7.182	3.389	-0.292
30.00	6.718	-0.094	-3.947	-7.260	3.311	-0.339

Figure B.30. Computer Tabulated Force and Moment Data for Missile III
 22° Roll, Fin No. 2, Blunt Nose

RUN NUMBER IS 45
 DATA TAKEN 14:28:39 10-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	R01CO
0.35	0.008	0.277	0.013	-0.032	0.011	-0.009
2.22	0.279	0.274	-0.251	-0.312	0.714	-0.013
4.19	0.560	0.261	-0.533	-0.713	0.604	-0.017
6.10	0.891	0.240	-0.968	-1.140	1.132	-0.025
8.16	1.220	0.228	-1.206	-1.605	1.603	-0.028
10.27	1.632	0.212	-1.631	-2.196	2.200	-0.038
12.27	2.079	0.195	-2.075	-2.817	2.833	-0.053
14.00	2.441	0.183	-2.434	-3.202	3.290	-0.048
16.21	2.897	0.173	-2.929	-3.851	3.840	-0.035
17.90	3.310	0.164	-3.340	-4.398	4.355	-0.015
19.75	3.713	0.153	-3.776	-4.889	4.843	-0.013
22.23	4.371	0.139	-4.175	-5.465	5.570	0.000
24.21	4.991	0.008	-5.074	-6.238	6.120	0.016
26.26	5.641	-0.034	-5.750	-6.002	6.712	0.098
28.12	6.219	-0.069	-6.391	-7.181	6.800	0.092
30.00	6.800	-0.113	-7.010	-7.306	7.103	0.027

Figure B.31. Computer Tabulated Force and Moment Data for Missile III
 45° Roll, Fin No. 2, Blunt Nose

RUN NUMBER IS 46
 DATA TAKEN 11:18:26 10-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMCO	ROLCO
-0.18	-0.119	0.272	0.000	0.000	0.013	-0.015
2.28	0.357	0.262	0.006	-0.168	0.011	-0.020
4.37	0.757	0.252	0.004	-1.002	0.012	-0.022
6.37	1.204	0.228	-0.003	-1.515	0.037	-0.026
8.32	1.691	0.213	-0.011	-2.139	0.054	-0.034
10.27	2.241	0.192	-0.021	-2.874	0.089	-0.050
12.28	2.806	0.176	-0.029	-3.676	0.094	-0.052
14.27	3.339	0.164	-0.031	-4.228	0.103	-0.051
16.30	3.838	0.082	-0.044	-4.815	0.090	-0.044
17.80	4.229	0.048	-0.034	-5.266	0.131	-0.063
20.30	4.821	0.007	-0.017	-5.857	0.131	-0.085
22.24	5.304	-0.031	-0.005	-6.315	0.131	-0.112
24.20	5.817	-0.069	-0.002	-6.735	0.167	-0.141
26.21	6.346	-0.114	-0.043	-7.106	0.193	-0.097
28.12	6.712	-0.130	-0.067	-7.243	0.231	-0.070
30.00	7.101	-0.143	-0.129	-7.288	0.204	-0.081

Figure B.32. Computer Tabulated Force and Moment Data for Missile III
 0° Roll, Fin No. 2, Pointed Nose

RUN NUMBER IS 47
 DATA TAKEN 15101131 10-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROLCO
-0.04	-0.054	0.260	0.042	0.080	-0.052	-0.005
2.38	0.403	0.262	-0.158	-0.441	0.154	-0.010
4.22	0.755	0.248	-0.299	-0.880	0.366	-0.016
6.27	1.161	0.224	-0.474	-1.375	0.628	-0.022
7.84	1.482	0.202	-0.655	-1.830	0.868	-0.026
10.28	2.097	0.182	-0.976	-2.429	1.365	-0.048
12.30	2.593	0.155	-1.266	-3.234	1.736	-0.052
14.24	3.093	0.123	-1.555	-3.793	2.065	-0.041
16.29	3.596	0.090	-1.834	-4.319	2.404	-0.051
17.72	3.864	0.070	-2.053	-4.652	2.711	-0.062
20.28	4.462	0.028	-2.464	-5.214	3.176	-0.109
22.23	4.742	-0.004	-2.772	-5.617	3.422	-0.174
24.18	5.309	-0.043	-2.996	-6.039	3.579	-0.284
26.26	6.007	-0.077	-3.185	-6.347	3.840	-0.348
28.29	6.380	-0.095	-3.517	-6.396	3.889	-0.366
30.00	6.692	-0.113	-3.632	-6.516	3.966	-0.431

Figure B.33. Computer Tabulated Force and Moment Data for Missile III
 22° Roll, Fin No. 2, Pointed Nose

RUN NUMBER IS 48
 DATA TAKEN 15:13:54 10-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROLCO
-0.21	-0.071	0.219	0.110	0.078	-0.130	-0.005
2.24	0.228	0.242	-0.270	-0.343	0.323	-0.012
4.35	0.583	0.229	-0.549	-0.487	0.656	-0.017
6.32	0.888	0.210	-0.842	-1.027	1.083	-0.023
8.29	1.239	0.188	-1.230	-1.577	1.575	-0.029
10.27	1.659	0.174	-1.652	-2.144	2.160	-0.041
12.30	2.099	0.154	-2.116	-2.696	2.752	-0.054
14.32	2.529	0.132	-2.577	-3.100	3.272	-0.063
16.29	2.980	0.101	-3.039	-3.656	3.779	-0.059
17.75	3.326	0.075	-3.395	-4.017	4.176	-0.038
20.30	3.962	0.020	-4.124	-4.738	4.957	-0.034
22.25	4.533	-0.008	-4.681	-5.343	5.403	-0.022
24.18	5.161	-0.042	-5.309	-5.719	5.863	-0.023
26.23	5.814	-0.084	-5.967	-6.050	6.125	-0.032
28.28	6.426	-0.120	-6.616	-6.205	6.321	-0.063
30.00	7.030	-0.180	-7.140	-6.309	6.462	-0.106

Figure B.34. Computer Tabulated Force and Moment Data for Missile III
 45° Roll, Fin No. 2, Pointed Nose

RUN NUMBER IS 51
 DATA TAKEN 161118 10-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMO	ROLCO
0.25	-0.026	0.263	0.016	0.006	-0.001	-0.015
2.30	0.331	0.244	0.010	-0.197	0.001	-0.017
4.17	0.730	0.231	0.008	-0.497	0.000	-0.021
6.33	1.206	0.230	-0.011	-0.881	0.009	-0.024
8.33	1.704	0.227	-0.003	-1.384	0.012	-0.028
10.12	2.269	0.220	-0.012	-1.915	0.030	-0.032
12.29	2.955	0.201	-0.027	-2.676	0.021	-0.030
14.33	3.567	0.186	-0.037	-3.313	0.030	-0.033
15.95	4.070	0.158	-0.039	-3.848	0.034	-0.036
18.20	4.739	0.119	-0.053	-4.551	0.044	-0.035
20.24	5.451	0.085	-0.082	-5.266	0.079	-0.032
22.24	6.117	0.053	-0.087	-5.909	0.106	-0.038
24.19	6.857	0.010	-0.098	-6.704	0.105	-0.035
26.24	7.551	-0.035	-0.092	-7.400	0.036	-0.049
28.29	8.067	-0.037	-0.147	-7.896	0.194	-0.045
30.00	8.403	-0.037	-0.176	-7.964	0.137	-0.036

Figure B.35. Computer Tabulated Force and Moment Data for Missile III
 0° Roll, Fin No. 3, Blunt Nose

RUN NUMBER 18 52
 DATA TAKEN 16127119 10-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMCD	ROLCO
-0.21	-0.055	0.243	0.040	0.107	-0.050	-0.011
2.23	0.356	0.249	-0.146	-0.128	0.055	-0.014
4.38	0.744	0.238	-0.323	-0.419	0.208	-0.021
6.70	1.018	0.229	-0.436	-0.613	0.329	-0.025
8.31	1.614	0.211	-0.759	-1.220	0.686	-0.039
10.21	2.168	0.197	-1.063	-1.799	1.039	-0.044
12.29	2.709	0.173	-1.430	-2.507	1.474	-0.023
14.29	3.307	0.147	-1.771	-3.180	1.818	0.009
15.92	3.861	0.123	-2.055	-3.696	2.156	0.034
17.72	4.373	0.094	-2.325	-4.258	2.533	0.069
19.73	5.022	0.067	-2.827	-4.950	2.973	0.146
22.25	5.859	0.038	-3.393	-5.728	3.530	0.269
24.18	6.471	0.010	-3.722	-6.147	3.477	0.320
26.22	7.101	-0.019	-4.124	-6.532	3.851	0.338
28.04	7.585	-0.037	-4.461	-6.758	3.752	0.395
30.00	8.273	-0.082	-4.910	-7.113	3.817	0.502

Figure B.36. Computer Tabulated Force and Moment Data for Missile III
 22° Roll, Fin No. 3, Blunt Nose

RUN NUMBER IS 33
 DATA TAKEN 07:56:54 11-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROLCO
0.12	-0.038	0.266	0.057	0.021	-0.025	-0.014
2.10	0.206	0.256	-0.193	-0.124	0.123	-0.017
4.22	0.522	0.243	-0.304	-0.373	0.366	-0.020
6.37	0.866	0.236	-0.070	-0.481	0.676	-0.025
8.17	1.216	0.224	-1.212	-1.042	1.058	-0.033
10.12	1.724	0.212	-1.736	-1.629	1.615	-0.031
12.22	2.279	0.188	-2.286	-2.248	2.253	-0.033
14.16	2.774	0.179	-2.798	-2.827	2.803	-0.022
16.34	3.374	0.151	-3.388	-3.482	3.442	-0.015
18.16	3.853	0.134	-3.201	-4.023	3.984	-0.014
19.73	4.316	0.097	-4.384	-4.520	4.490	-0.005
22.27	5.163	0.062	-5.280	-5.408	5.361	0.036
24.21	5.884	0.042	-6.042	-6.099	6.027	0.077
24.26	6.713	0.007	-6.924	-6.771	6.719	0.070
28.20	7.451	-0.028	-7.692	-7.260	7.245	0.100
30.00	8.251	-0.053	-8.492	-7.393	7.203	0.037

Figure B.37. Computer Tabulated Force and Moment Data for Missile III
 45° Roll, Fin No. 3, Blunt Nose

RUN NUMBER IS 54
 DATA TAKEN 08113124 11-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CN	YMCO.	ROLCO
0.20	-0.074	0.252	0.014	0.016	-0.009	-0.014
2.13	0.302	0.245	0.016	-0.209	0.000	-0.017
4.45	0.739	0.238	0.014	-0.521	-0.006	-0.024
6.38	1.140	0.221	0.014	-0.846	-0.001	-0.026
8.10	1.636	0.221	0.000	-1.284	0.004	-0.030
10.12	2.242	0.209	-0.013	-1.702	0.015	-0.035
12.27	2.907	0.188	-0.018	-2.580	0.025	-0.038
13.73	3.402	0.178	-0.014	-3.073	0.036	-0.045
16.18	4.134	0.150	-0.022	-3.804	0.048	-0.050
18.18	4.754	0.112	-0.040	-4.387	0.072	-0.065
19.71	5.235	0.086	-0.041	-4.856	0.120	-0.083
22.28	6.164	0.042	-0.025	-5.752	0.197	-0.126
24.22	6.891	0.000	-0.034	-6.434	0.224	-0.145
25.77	7.196	-0.036	-0.061	-7.012	0.199	-0.119
27.85	8.014	-0.042	-0.092	-7.141	0.307	-0.135
30.00	8.684	-0.076	-0.167	-7.447	0.227	-0.104

Figure B.38. Computer Tabulated Force and Moment Data for Missile III
 0° Roll, Fin No. 3, Pointed Nose

RUN NUMBER IS 75
 DATA TAKEN 08:25:25 11-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROLCO
0.02	-0.055	0.239	0.034	0.074	-0.037	-0.014
2.24	0.348	0.212	-0.129	-0.147	0.053	-0.016
4.32	0.689	0.229	-0.301	-0.400	0.190	-0.022
6.20	1.120	0.224	-0.500	-0.769	0.389	-0.031
8.20	1.568	0.201	-0.727	-1.173	0.634	-0.040
10.27	2.174	0.191	-1.059	-1.706	1.034	-0.049
12.30	2.792	0.165	-1.418	-2.437	1.433	-0.031
14.10	3.367	0.141	-1.762	-3.012	1.804	-0.003
16.07	3.932	0.120	-2.113	-3.607	2.152	0.040
18.37	4.670	0.082	-2.571	-4.260	2.567	0.099
20.05	5.194	0.066	-2.941	-4.707	2.817	0.162
22.25	5.907	0.028	-3.334	-5.390	3.399	0.343
24.22	6.601	0.003	-3.635	-5.792	3.519	0.250
26.23	7.232	-0.004	-4.222	-6.023	3.703	0.325
28.13	7.770	-0.038	-4.779	-6.151	3.974	0.315
30.00	8.424	-0.084	-5.103	-6.317	3.973	0.327

Figure B.39. Computer Tabulated Force and Moment Data for Missile III
 22° Roll, Fin No. 3, Pointed Nose

RUN NUMBER IS 56
 DATA TAKEN 08137150 11-MAR-80

COEFFICIENTS ABOUT THE BODY AXIS

ALPHA (DEG)	CN	CA	CY	CM	YMC0	ROLCO
-0.19	-0.050	0.249	0.074	0.050	-0.106	-0.013
2.15	0.286	0.249	-0.236	-0.112	0.081	-0.017
3.88	0.508	0.236	-0.470	-0.279	0.250	-0.022
6.30	0.926	0.218	-0.905	-0.615	0.610	-0.028
8.26	1.287	0.207	-1.277	-0.997	1.007	-0.035
10.30	1.773	0.189	-1.781	-1.567	1.579	-0.039
12.26	2.336	0.173	-2.356	-2.145	2.180	-0.045
14.27	2.974	0.163	-2.915	-2.678	2.758	-0.063
16.22	3.386	0.140	-3.447	-3.197	3.254	-0.068
17.72	3.793	0.108	-3.863	-3.577	3.621	-0.067
19.74	4.419	0.082	-4.491	-4.126	4.155	-0.070
22.27	5.205	0.056	-5.339	-4.776	4.763	-0.068
24.23	6.107	0.034	-6.164	-5.243	5.264	-0.068
26.23	6.862	0.006	-6.953	-5.577	5.612	-0.089
28.24	7.607	-0.026	-7.683	-5.855	5.881	-0.096
30.00	8.570	-0.415	-8.705	-6.230	6.273	-0.145

Figure B.40. Computer Tabulated Force and Moment Data for Missile III
 45° Roll, Fin No. 3, Pointed Nose

RUN NUMBER IS 1
 DATA TAKEN 16122139 13-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CN	CNW	CLW
0.16	-0.002	0.1438	-0.020	-0.031	0.021	0.021
2.10	0.108	0.1511	-0.023	0.271	0.015	0.015
4.18	0.235	0.1645	-0.044	0.563	0.011	0.015
6.10	0.403	0.1908	-0.072	0.871	0.010	0.033
7.97	0.599	0.2298	-0.108	1.220	-0.003	0.046
9.90	0.838	0.2849	-0.176	1.566	0.019	0.093
11.92	1.085	0.3672	-0.279	1.931	0.045	0.207
13.87	1.323	0.4505	-0.400	2.243	0.086	0.384
15.93	1.607	0.5861	-0.596	2.614	0.229	0.568
17.95	1.957	0.7298	-0.839	2.935	0.376	0.808
19.97	2.284	0.9077	-1.155	3.261	0.655	1.237
21.84	2.630	1.1148	-1.501	3.536	0.968	1.548
23.95	3.047	1.3724	-1.959	3.806	1.377	1.862
26.32	3.304	1.6865	-2.493	4.253	1.810	2.031
27.98	3.803	1.9239	-2.782	4.447	1.938	1.924
29.70	4.190	2.2394	-3.099	4.594	1.942	1.643

Figure B.41. Computer Tabulated Force and Moment Data for Missile I
 11° Roll, No Fin, Blunt Nose

RUN NUMBER IS 2
 DATA TAKEN 08:13:56 14-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CLW
-0.36	0.021	0.1364	-0.004	-0.076	0.005	0.006
2.01	0.146	0.1487	-0.016	0.231	-0.001	-0.001
4.10	0.284	0.1736	-0.014	0.541	0.001	0.003
5.99	0.173	0.2047	-0.025	0.830	0.001	0.004
7.89	0.700	0.2471	-0.051	1.168	0.004	0.006
9.63	0.976	0.3137	-0.083	1.471	0.014	0.031
11.72	1.369	0.4239	-0.137	1.739	0.038	0.083
13.74	1.724	0.5626	-0.201	1.970	0.093	0.144
15.78	2.229	0.7358	-0.296	2.200	0.116	0.273
17.96	2.787	0.9783	-0.427	2.477	0.196	0.422
19.90	3.262	1.2367	-0.566	2.740	0.379	0.485
21.97	3.868	1.5708	-0.747	3.105	0.505	0.655
23.98	4.476	1.9542	-0.957	3.462	0.720	0.778
25.99	5.048	2.3689	-1.195	3.873	0.919	0.902
27.98	5.589	2.8201	-1.448	4.293	1.264	0.985
29.72	6.003	3.2310	-1.780	4.691	1.687	1.030

Figure B.42. Computer Tabulated Force and Moment Data for Missile I
 33° Roll, No Fin, Blunt Nose

RUN NUMBER IS 3
 DATA TAKEN 10:48:124 13-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CI	CD	CC	CM	CNW	CLW
0.13	0.016	0.1364	-0.004	0.002	0.011	0.011
2.01	0.085	0.1472	-0.012	0.267	0.001	0.003
4.15	0.197	0.1620	-0.005	0.586	-0.005	-0.003
6.03	0.301	0.1780	-0.008	0.880	-0.001	-0.003
7.89	0.448	0.2030	-0.030	1.190	0.001	0.011
9.87	0.594	0.2361	-0.084	1.511	0.013	0.028
11.96	0.762	0.2939	-0.160	1.843	0.044	0.112
13.95	0.978	0.3555	-0.257	2.178	0.120	0.187
15.91	1.182	0.4414	-0.384	2.508	0.137	0.423
17.92	1.383	0.5320	-0.560	2.818	0.332	0.581
20.01	1.599	0.6561	-0.790	3.128	0.553	0.878
21.86	1.867	0.7936	-1.062	3.415	0.853	1.174
23.66	2.149	0.9470	-1.365	3.608	1.106	1.436
25.45	2.443	1.1377	-1.703	3.765	1.323	1.647
28.00	2.792	1.3802	-2.016	3.859	1.383	1.673
29.75	3.092	1.6119	-2.239	3.907	1.229	1.565

Figure B.43. Computer Tabulated Force and Moment Data for Missile II
 11° Roll, No Fin, Blunt Nose

RUN NUMBER IS 4
 DATA TAKEN 16102112 13-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CLW
0.22	0.055	0.1348	-0.072	0.081	-0.007	-0.007
2.05	0.176	0.1497	-0.026	0.346	0.033	0.038
4.13	0.274	0.1709	-0.037	0.633	0.034	0.043
6.12	0.422	0.1897	-0.047	0.907	0.043	0.049
7.93	0.569	0.2230	-0.064	1.201	0.052	0.047
9.70	0.812	0.2608	-0.106	1.518	0.057	0.073
11.87	1.120	0.3589	-0.165	1.727	0.121	0.162
13.92	1.196	0.4650	-0.284	1.893	0.174	0.290
15.96	1.903	0.6201	-0.419	2.034	0.238	0.407
17.97	2.351	0.8156	-0.582	2.168	0.421	0.697
19.97	2.770	1.0390	-0.795	2.362	0.701	0.872
21.86	3.240	1.3140	-1.046	2.577	0.930	1.140
23.85	3.751	1.6515	-1.332	2.849	1.235	1.329
25.71	4.240	1.9718	-1.678	3.096	1.616	1.544
27.91	4.774	2.3800	-2.107	3.383	2.151	1.739
29.70	5.213	2.7562	-2.497	3.648	2.647	1.814

Figure B.44. Computer Tabulated Force and Moment Data for Missile II
 33° Roll, No Fin, Blunt Nose

RUN NUMBER IS 5
 DATA TAKEN 09118136 14-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CLW
-0.11	-0.043	0.1452	0.005	-0.079	-0.001	-0.001
2.00	0.047	0.1514	-0.005	0.208	0.005	0.001
3.99	0.130	0.1518	-0.004	0.485	0.004	0.001
5.96	0.220	0.1658	-0.007	0.758	0.006	0.005
7.93	0.328	0.1874	-0.016	1.065	0.025	0.001
9.93	0.442	0.2198	-0.027	1.330	0.024	0.021
11.81	0.593	0.2586	-0.034	1.602	0.034	0.024
13.81	0.698	0.2920	-0.059	1.835	0.060	0.110
16.18	0.898	0.3553	-0.112	2.120	0.092	0.198
17.91	1.032	0.4074	-0.173	2.339	0.091	0.360
19.90	1.195	0.4652	-0.277	2.584	0.357	0.371
21.88	1.343	0.5078	-0.451	2.858	0.517	0.671
24.03	1.549	0.7186	-0.708	3.130	0.789	1.060
26.32	1.766	0.8607	-1.031	3.350	1.140	1.326
27.65	1.885	0.9387	-1.166	3.452	1.318	1.700
29.57	2.054	1.0031	-1.407	3.592	1.517	2.075

Figure B.45. Computer Tabulated Force and Moment Data for Missile III
 11° Roll, No Fin, Blunt Nose

RUN NUMBER 13 6
 DATA TAKEN 10:10:34 14-JAN-82

COEFFICIENTS AROUND THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CH	CNW	CLW
0.07	0.003	0.1320	0.000	-0.029	0.010	0.018
1.76	0.062	0.1534	-0.007	0.203	0.001	0.000
4.09	0.156	0.1537	-0.002	0.493	0.002	0.004
6.05	0.263	0.1725	-0.009	0.766	0.007	0.013
7.82	0.361	0.1930	-0.018	1.036	0.013	0.027
9.74	0.510	0.2307	-0.027	1.274	0.019	0.030
11.97	0.681	0.2751	-0.003	1.510	0.040	-0.008
13.88	0.869	0.3307	-0.078	1.687	0.052	0.131
15.84	1.094	0.4067	-0.139	1.804	0.197	0.155
17.70	1.441	0.5176	-0.230	1.819	0.410	0.196
19.87	1.759	0.6775	-0.399	1.906	0.631	0.468
21.77	2.079	0.8335	-0.610	2.060	0.895	0.774
24.07	2.462	1.1025	-0.924	2.164	1.460	1.068
25.97	2.908	1.3743	-1.301	2.118	1.956	1.572
27.63	3.267	1.6321	-1.591	2.066	2.427	1.746
29.62	3.703	1.9528	-2.052	2.137	3.055	2.043

Figure B.46. Computer Tabulated Force and Moment Data for Missile III
 33° Roll, No Fin, Blunt Nose

RUN NUMBER IS 8
 DATA TAKEN 08:34:43 14-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CIW
0.06	-0.021	0.1232	-0.029	-0.066	0.019	0.019
2.03	0.071	0.1349	-0.032	0.197	0.015	0.018
4.01	0.133	0.1446	-0.032	0.301	0.019	0.024
6.12	0.212	0.1600	-0.043	0.335	0.017	0.034
7.89	0.239	0.1810	-0.038	1.113	0.017	0.045
9.67	0.471	0.2198	-0.047	1.434	0.030	0.043
12.01	0.629	0.2600	-0.062	1.751	0.032	0.083
13.80	0.754	0.3003	-0.072	1.795	0.046	0.148
16.00	0.938	0.3622	-0.151	2.300	0.070	0.210
17.86	1.082	0.4329	-0.225	2.635	0.260	0.265
19.85	1.208	0.5153	-0.296	2.970	0.338	0.416
21.82	1.445	0.6243	-0.398	3.288	0.460	0.622
23.96	1.645	0.7673	-0.574	3.604	0.634	0.971
26.23	1.928	0.9327	-0.693	3.893	0.884	1.346
28.14	2.111	1.0650	-0.932	4.126	1.222	1.742
29.67	2.270	1.1788	-1.144	4.298	1.466	2.090

Figure B.47. Computer Tabulated Force and Moment Data for Missile III
 11° Roll No Fin, Pointed Nose

RUN NUMBER IS 9
 DATA TAKEN 08104100 14-JAN-62

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CIW
-0.32	0.026	0.1200	-0.093	-0.023	0.037	0.056
2.02	0.181	0.1338	-0.068	0.265	0.032	0.042
4.07	0.271	0.1495	-0.072	0.576	0.035	0.053
6.06	0.370	0.1700	-0.075	0.837	0.032	0.064
7.90	0.462	0.1806	-0.074	1.153	0.033	0.067
9.88	0.406	0.2199	-0.081	1.446	0.015	0.074
11.66	0.819	0.2807	-0.111	1.666	0.084	0.094
14.08	1.027	0.3594	-0.190	1.874	0.210	0.178
15.97	1.353	0.4512	-0.289	2.063	0.412	0.213
17.91	1.620	0.5755	-0.433	2.208	0.611	0.424
19.90	1.941	0.7413	-0.520	2.355	0.803	0.599
22.19	2.343	0.9051	-0.724	2.538	1.431	0.728
24.30	2.779	1.2548	-1.122	2.738	1.920	1.117
26.12	3.146	1.5203	-1.397	2.927	2.186	1.398
27.90	3.494	1.8703	-1.670	3.010	2.520	1.502
29.61	4.163	2.3260	-2.036	3.104	3.032	1.679

Figure B.48. Computer Tabulated Force and Moment Data for Missile III
 33° Roll, No Fin, Pointed Nose

RUN NUMBER IS 10
 DATA TAKEN 11:18:40 14-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CLW
0.14	0.034	0.2259	-0.046	-0.040	0.041	0.042
1.71	0.371	0.2230	-0.042	-0.334	0.038	0.055
4.01	0.810	0.2540	-0.064	-0.687	0.054	0.072
6.30	1.338	0.3277	-0.084	-1.109	0.031	0.093
7.95	1.753	0.4200	-0.147	-1.454	0.036	0.162
10.27	2.454	0.6025	-0.215	-2.018	0.025	0.299
12.28	3.097	0.8051	-0.356	-2.553	-0.048	0.489
13.65	3.584	0.9851	-0.444	-2.924	-0.137	0.673
15.87	4.210	1.2746	-0.589	-3.438	-0.362	1.012
18.04	4.857	1.6341	-0.750	-4.011	-0.831	1.539
20.30	5.574	2.0687	-0.980	-4.527	-1.665	2.414
22.03	6.172	2.4721	-1.203	-4.994	-2.480	3.241
24.10	6.865	3.0020	-1.490	-5.516	-3.616	4.313
26.01	7.466	3.3241	-1.779	-5.874	-4.485	4.993
27.97	7.860	4.0089	-2.104	-5.955	-4.762	5.119
29.57	8.167	4.4030	-2.470	-5.861	-4.152	4.539

Figure B.49. Computer Tabulated Force and Moment Data for Missile I
 11° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 11
 DATA TAKEN 11137130 14-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CLW
-0.11	0.050	0.2413	-0.062	0.056	0.001	0.000
1.81	0.429	0.2349	-0.023	-0.260	0.033	0.047
4.12	0.929	0.2727	-0.041	-0.686	0.032	0.067
6.14	1.421	0.3406	-0.070	-1.074	0.055	0.106
7.87	1.926	0.4404	-0.101	-1.489	0.070	0.146
10.27	2.714	0.6559	-0.130	-2.141	0.063	0.241
11.97	3.362	0.8618	-0.204	-2.800	0.021	0.353
14.11	4.093	1.1689	-0.259	-3.093	-0.018	0.437
15.67	4.664	1.4339	-0.330	-3.466	-0.122	0.582
18.01	5.565	1.9020	-0.431	-4.037	-0.325	0.875
19.76	6.238	2.2978	-0.527	-4.413	-0.544	1.163
21.85	7.130	2.8795	-0.606	-4.871	-0.823	1.403
24.13	8.101	3.5788	-0.888	-5.341	-1.390	2.273
26.20	8.988	4.3116	-1.132	-5.603	-1.959	3.026
27.95	9.542	4.9054	-1.368	-5.690	-2.352	3.677
29.63	10.031	5.5195	-1.622	-5.574	-2.834	4.342

Figure B.50. Computer Tabulated Force and Moment Data for Missile I
 33° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 12
 DATA TAKEN 09:08:42 15-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CLW
-0.03	0.004	0.2139	-0.025	0.025	0.014	0.014
1.90	0.347	0.2110	-0.027	-0.269	0.014	0.012
4.07	0.762	0.2333	-0.040	-0.653	0.038	0.031
6.04	1.180	0.2907	-0.061	-1.067	0.067	0.061
7.93	1.632	0.3749	-0.102	-1.542	0.097	0.104
10.25	2.273	0.5364	-0.180	-2.177	0.119	0.197
11.66	2.685	0.6660	-0.233	-2.599	0.074	0.288
13.73	3.261	0.8752	-0.335	-3.215	-0.024	0.199
15.88	3.843	1.1306	-0.443	-3.812	-0.223	0.803
17.76	4.365	1.4066	-0.553	-4.379	-0.520	1.180
20.02	5.004	1.8089	-0.706	-5.078	-1.082	1.809
21.77	5.480	2.1473	-0.820	-5.504	-1.755	2.268
23.83	6.035	2.5712	-0.970	-5.957	-2.455	2.961
26.20	6.515	3.0612	-1.103	-6.231	-3.565	3.532
27.69	6.757	3.3604	-1.306	-6.376	-3.969	3.749
29.08	7.130	3.8017	-1.541	-6.592	-3.910	3.147

Figure B.51. Computer Tabulated Force and Moment Data for Missile II
 11° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 13
 DATA TAKEN 09142120 15-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CLW
-0.33	0.050	0.2230	-0.078	0.181	0.055	-0.056
2.07	0.321	0.2234	-0.042	-0.210	0.055	0.061
4.01	0.894	0.2562	-0.058	-0.579	0.080	0.077
6.11	1.375	0.3268	-0.080	-1.091	0.126	0.121
8.10	1.906	0.4373	-0.127	-1.618	0.159	0.169
10.26	2.553	0.6108	-0.207	-2.287	0.191	0.246
11.70	3.030	0.7646	-0.258	-2.746	0.159	0.327
13.98	3.764	1.0414	-0.358	-3.431	0.108	0.302
15.69	4.381	1.3152	-0.459	-3.983	0.037	0.735
17.64	5.102	1.6787	-0.571	-4.538	-0.189	1.035
19.60	5.785	2.1040	-0.719	-5.027	-0.475	1.469
22.13	6.725	2.7059	-0.915	-5.676	-0.999	2.198
24.11	7.489	3.2717	-1.160	-6.202	-1.649	2.972
26.06	8.235	3.9154	-1.411	-6.635	-2.451	3.659
28.22	8.927	4.5893	-1.737	-6.633	-3.086	4.555
29.98	9.064	4.9690	-1.917	-6.348	-3.356	4.638

Figure B.52. Computer Tabulated Force and Moment Data for Missile II
 33° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 14
 DATA TAKEN 15119123 15-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CI	CD	CC	CM	CNW	CI W
0.27	0.040	0.2150	-0.007	-0.066	0.004	0.004
1.74	0.287	0.2168	-0.023	-0.312	0.007	0.014
4.12	0.713	0.2440	-0.034	-0.743	0.012	0.018
6.01	1.057	0.2871	-0.037	-1.158	0.056	0.077
8.01	1.533	0.3732	-0.073	-1.676	0.091	0.137
9.82	1.970	0.4835	-0.113	-2.252	0.173	0.204
11.95	2.537	0.6520	-0.151	-2.952	0.216	0.268
13.73	2.974	0.8253	-0.186	-3.528	0.226	0.341
15.94	3.528	1.0623	-0.251	-4.217	0.248	0.442
18.27	4.108	1.3683	-0.316	-4.985	0.242	0.615
20.00	4.533	1.6350	-0.385	-5.561	0.155	0.826
21.74	4.976	1.9446	-0.493	-6.189	-0.094	1.209
23.92	5.515	2.3679	-0.594	-6.876	-0.389	1.502
26.21	6.014	2.7717	-0.660	-7.109	0.254	0.865
27.65	6.076	3.0394	-0.695	-7.397	0.427	0.738
29.56	6.380	3.4370	-0.791	-7.704	0.632	0.716

Figure B.53. Computer Tabulated Force and Moment Data for Missile III
 11° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 15
 DATA TAKEN 15133149 15-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CLW
-0.23	-0.001	0.2173	-0.009	0.052	-0.045	-0.016
1.87	0.371	0.2191	-0.022	-0.301	0.009	0.019
3.98	0.768	0.2481	-0.039	-0.713	0.013	0.034
6.13	1.207	0.3047	-0.056	-1.213	0.063	0.100
7.95	1.600	0.3893	-0.104	-1.706	0.104	0.177
9.72	2.103	0.5042	-0.150	-2.332	0.207	0.257
11.89	2.728	0.7009	-0.237	-3.196	0.329	0.433
13.84	3.306	0.9126	-0.320	-3.995	0.385	0.460
15.86	3.886	1.1798	-0.419	-4.784	0.427	0.437
18.07	4.476	1.1877	-0.497	-5.487	0.431	0.455
19.79	5.017	1.8121	-0.605	-6.050	0.301	1.295
22.18	5.724	2.3033	-0.794	-6.793	0.102	1.790
24.05	6.239	2.7302	-0.998	-7.174	0.073	2.125
26.14	6.711	3.2293	-1.164	-7.409	0.024	2.271
28.21	7.313	3.7910	-1.327	-7.867	-0.714	2.804
29.45	7.637	4.1767	-1.432	-7.994	-1.202	3.149

Figure B.54. Computer Tabulated Force and Moment Data for Missile III
 33° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 16
 DATA TAKEN 11:05:29 10-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CLW
-0.04	0.015	0.1961	-0.001	-0.037	-0.006	-0.006
1.07	0.223	0.1892	-0.005	-0.336	0.001	-0.005
4.23	0.435	0.2094	-0.017	-0.719	0.032	0.018
6.08	0.747	0.2508	-0.036	-1.127	0.056	0.057
7.99	1.232	0.3102	-0.049	-1.651	0.092	0.091
9.84	1.680	0.4128	-0.075	-2.161	0.143	0.113
11.63	2.094	0.5305	-0.111	-2.743	0.229	0.142
13.82	2.470	0.6872	-0.148	-3.525	0.261	0.224
15.98	2.996	0.9003	-0.198	-4.296	0.424	0.249
17.87	3.363	1.0751	-0.228	-5.048	0.525	0.211
19.71	3.781	1.3336	-0.230	-5.600	0.554	0.194
21.67	4.224	1.6722	-0.274	-6.432	0.597	0.237
24.07	4.700	2.0582	-0.324	-7.234	0.638	0.248
26.19	5.037	2.3851	-0.283	-7.512	1.003	-0.385
27.85	5.082	2.5893	-0.273	-7.405	2.365	-1.445
29.72	5.290	2.0848	-0.304	-7.620	2.665	-1.187

Figure B.55. Computer Tabulated Force and Moment Data for Missile IV
 11° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 17
 DATA TAKEN 11:27:41 10-JAN-82

COEFFICIENTS AROUND THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CLW
0.22	0.079	0.2060	-0.081	-0.051	0.022	0.023
1.79	0.348	0.1778	-0.021	-0.295	-0.003	-0.001
4.13	0.683	0.2197	-0.025	-0.714	0.022	0.016
5.93	0.979	0.2557	-0.044	-1.099	0.035	0.040
7.73	1.261	0.3114	-0.067	-1.590	0.097	0.087
9.72	1.611	0.4381	-0.107	-2.273	0.173	0.158
11.71	2.196	0.5561	-0.164	-2.976	0.241	0.221
13.91	2.741	0.7495	-0.231	-3.613	0.361	0.313
15.89	3.194	0.9140	-0.290	-4.696	0.512	0.391
17.89	3.657	1.1692	-0.336	-5.501	0.538	0.508
19.92	4.196	1.4938	-0.394	-6.318	0.804	0.470
21.88	4.657	1.8230	-0.476	-7.129	1.069	0.464
24.11	5.084	2.2181	-0.541	-7.816	1.444	0.254
25.87	5.177	2.4551	-0.533	-7.720	3.016	-1.262
27.67	5.402	2.7339	-0.577	-8.151	3.332	-1.425
29.58	5.726	3.1197	-0.617	-8.405	3.418	-1.384

Figure B.56. Computer Tabulated Force and Moment Data for Missile IV
 33° Roll, Fin No. 1, Blunt Nose

RUN NUMBER IS 18
 DATA TAKEN 11:10:23 10-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CLW
0.13	0.033	0.2191	-0.010	-0.063	0.004	0.004
1.73	0.320	0.2188	-0.026	-0.317	0.009	0.016
3.96	0.703	0.2350	-0.040	-0.697	0.027	0.048
5.91	1.118	0.2655	-0.055	-1.130	0.050	0.088
7.97	1.553	0.3470	-0.076	-1.619	0.072	0.151
9.71	1.980	0.4743	-0.131	-2.129	0.131	0.210
11.77	2.507	0.6409	-0.193	-2.809	0.177	0.277
13.98	3.118	0.8322	-0.230	-3.433	0.202	0.414
15.70	3.569	1.0491	-0.284	-3.974	0.222	0.529
18.00	4.114	1.3461	-0.362	-4.653	0.211	0.703
19.88	4.609	1.6413	-0.418	-5.213	0.256	0.942
21.79	5.114	1.9827	-0.524	-5.817	0.332	1.278
23.76	5.618	2.3846	-0.600	-6.384	0.315	1.533
26.13	5.961	2.8120	-0.615	-6.373	0.309	0.774
27.63	6.212	3.1025	-0.620	-6.768	1.161	0.442
29.58	6.507	3.4764	-0.713	-6.776	1.003	0.776

Figure B.57. Computer Tabulated Force and Moment Data for Missile III
 11° Roll, Fin No. 1, Pointed Nose

RUN NUMBER IS 19
 DATA TAKEN 11130138 15-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CLW
-0.37	-0.007	0.2374	-0.033	0.085	-0.049	-0.052
1.92	0.134	0.2340	-0.053	-0.287	0.015	0.031
4.01	0.798	0.2627	-0.054	-0.654	0.024	0.060
6.01	1.224	0.3086	-0.077	-1.129	0.075	0.128
7.71	1.600	0.3774	-0.099	-1.568	0.125	0.191
10.26	2.284	0.5441	-0.171	-2.407	0.236	0.297
11.65	2.722	0.6787	-0.239	-2.896	0.261	0.421
13.77	3.329	0.9037	-0.317	-3.601	0.203	0.684
15.72	3.930	1.1786	-0.450	-4.274	0.290	0.916
17.67	4.524	1.4877	-0.571	-4.896	0.182	1.224
20.00	5.213	1.9112	-0.723	-5.566	0.076	1.587
21.74	5.745	2.2759	-0.871	-6.056	-0.022	2.013
24.08	6.480	2.8363	-1.100	-6.502	0.080	2.450
25.98	7.112	3.3813	-1.359	-6.978	-0.570	3.243
28.03	7.519	3.8757	-1.726	-6.761	-0.677	3.574
29.51	7.797	4.2563	-1.927	-6.523	-0.410	3.498

Figure B.58. Computer Tabulated Force and Moment Data for Missile III
 33° Roll, Fin No. 1, Pointed Nose

RUN NUMBER IS 20
 DATA TAKEN 15:08:41 14-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CI	CD	CC	CM	CNW	CLW
0.26	0.035	0.2311	-0.019	-0.075	0.006	0.006
2.09	0.410	0.2398	-0.018	-0.562	0.012	0.020
3.99	0.801	0.2699	-0.035	-1.077	0.031	0.039
6.11	1.260	0.3252	-0.046	-1.692	0.032	0.047
7.98	1.760	0.4190	-0.055	-2.369	0.079	0.137
9.73	2.238	0.5334	-0.115	-3.023	0.116	0.219
11.72	2.778	0.7023	-0.170	-3.782	0.184	0.308
13.75	3.283	0.8974	-0.204	-4.486	0.261	0.390
15.90	3.852	1.1069	-0.301	-5.242	0.360	0.502
17.89	4.248	1.3231	-0.401	-6.088	0.466	0.671
19.73	4.667	1.6567	-0.497	-6.358	0.679	0.778
21.68	5.142	1.9854	-0.589	-6.969	0.980	0.737
23.77	5.582	2.3676	-0.616	-7.487	1.145	-0.031
25.99	5.963	2.7803	-0.610	-7.803	1.411	-0.782
27.92	6.202	3.0992	-0.604	-7.971	1.800	-1.328
29.60	6.186	3.4447	-0.679	-8.286	2.064	-1.540

Figure B.59. Computer Tabulated Force and Moment Data for Missile III
 11° Roll, Fin No. 2, Blunt Nose

RUN NUMBER 18 21
 DATA TAKEN 14:14:18 14-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CI	CD	CC	CM	CNW	CLW
0.26	0.065	0.2376	-0.023	-0.026	0.018	0.019
1.75	0.448	0.2450	-0.031	-0.476	0.007	0.021
4.05	0.881	0.2754	-0.037	-1.036	0.015	0.041
6.01	1.293	0.3368	-0.065	-1.439	0.051	0.092
8.11	1.866	0.4531	-0.110	-2.471	0.120	0.185
9.71	2.319	0.5665	-0.153	-3.115	0.204	0.265
11.78	2.910	0.7531	-0.222	-3.982	0.304	0.395
13.69	3.450	0.9525	-0.295	-4.710	0.462	0.481
15.82	4.045	1.2266	-0.364	-5.531	0.625	0.515
17.91	4.589	1.6277	-0.439	-6.217	0.964	0.432
20.18	5.279	1.9379	-0.601	-6.985	1.195	0.446
22.23	5.916	2.3740	-0.806	-7.769	1.163	0.903
24.08	6.452	2.8214	-1.008	-8.349	1.364	1.170
24.28	6.962	3.3457	-1.222	-8.683	1.855	0.919
27.99	7.287	3.7520	-1.294	-8.758	2.121	0.573
29.47	7.532	4.0885	-1.397	-8.630	2.120	0.312

Figure No. B.60. Computer Tabulated Force and Moment Data for Missile III
 33° Roll, Fin No. 2, Blunt Nose

RUN NUMBER IS 22
 DATA TAKEN 0014648 15-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CLW
0.17	0.111	0.2156	-0.050	-0.025	0.011	0.012
1.97	0.474	0.2200	-0.038	-0.476	0.011	0.015
4.20	0.951	0.2727	-0.042	-1.047	0.014	0.032
6.07	1.347	0.3217	-0.054	-1.619	0.030	0.035
7.95	1.833	0.4121	-0.106	-2.275	0.070	0.139
10.33	2.178	0.5052	-0.136	-3.137	0.123	0.219
11.97	2.942	0.7373	-0.184	-3.710	0.129	0.298
13.93	3.126	0.9333	-0.242	-4.371	0.141	0.396
16.06	3.914	1.1804	-0.344	-5.024	0.296	0.587
17.90	4.345	1.4206	-0.398	-5.542	0.325	0.656
19.70	4.762	1.6883	-0.507	-6.058	0.799	0.767
21.64	5.263	2.0428	-0.631	-6.671	1.020	0.674
24.15	5.697	2.4653	-0.389	-7.026	1.541	-0.460
26.25	6.030	2.8362	-0.364	-7.264	1.913	-1.436
27.86	6.243	3.1216	-0.320	-7.383	2.170	-1.795
29.66	6.478	3.4496	-0.108	-7.500	2.507	-2.061

Figure B.61. Computer Tabulated Force and Moment Data for Missile III
 11° Roll Fin No. 2, Pointed Nose

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 permit fully legible reproduction

RUN NUMBER IS 23
 DATA TAKEN 0812916 15-JAN-82

COEFFICIENTS AROUND THE WIND AXIS

ALPHA (DEG)	CI	CD	CC	CM	CNW	CLW
0.20	0.023	0.2276	-0.002	-0.073	-0.023	-0.022
1.97	0.372	0.2330	-0.012	-0.584	-0.016	-0.009
4.09	0.813	0.2667	-0.009	-1.095	-0.007	0.011
6.27	1.310	0.3340	-0.039	-1.767	0.011	0.023
8.44	1.830	0.4408	-0.091	-2.530	0.121	0.148
9.94	2.344	0.5618	-0.117	-3.230	0.207	0.230
11.94	2.901	0.7160	-0.225	-3.979	0.326	0.367
14.04	3.184	0.9618	-0.308	-4.698	0.417	0.489
15.73	3.997	1.2010	-0.398	-5.332	0.482	0.516
17.76	4.538	1.5003	-0.500	-5.704	0.507	0.529
19.81	5.154	1.8716	-0.617	-6.543	1.015	0.621
21.91	5.809	2.3177	-0.727	-7.263	1.200	0.861
24.16	6.508	2.8516	-1.089	-7.977	1.453	1.362
26.30	6.996	3.3491	-1.261	-8.055	2.096	0.937
28.03	7.267	3.7114	-1.395	-7.828	2.756	0.232
29.70	7.762	4.2429	-1.457	-7.944	3.363	0.204

Figure B.62. Computer Tabulated Force and Moment Data for Missile III
 33° Roll, Fin No. 2, Pointed Nose

RUN NUMBER IS 24
 DATA TAKEN 14:08:04 15-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CLW
-0.16	-0.008	0.2508	-0.012	-0.031	0.018	0.018
1.39	0.333	0.2460	-0.035	-0.260	0.032	0.033
3.99	0.737	0.2735	-0.025	-0.062	0.035	0.049
6.02	1.154	0.3302	-0.040	-0.965	0.050	0.035
7.77	1.611	0.4348	-0.069	-1.427	0.109	0.104
9.43	2.142	0.5470	-0.107	-2.042	0.172	0.149
11.68	2.806	0.7420	-0.163	-2.797	0.234	0.273
14.32	3.582	1.0433	-0.242	-3.718	0.283	0.411
15.93	4.035	1.2589	-0.294	-4.244	0.288	0.517
17.66	4.614	1.5580	-0.374	-4.934	0.371	0.638
19.48	5.141	1.8811	-0.444	-5.850	0.452	0.892
21.99	5.817	2.3741	-0.584	-6.398	0.302	1.383
24.11	6.406	2.8479	-0.582	-7.034	-0.452	1.260
26.19	6.920	3.3305	-0.637	-7.663	-0.609	1.323
27.88	7.287	3.7399	-0.854	-8.121	-0.893	2.352
29.48	7.542	4.1716	-1.115	-8.459	-1.310	3.290

Figure B.63. Computer Tabulated Force and Moment Data for Missile III
 11° Roll, Fin No. 3, Blunt Nose

RUN NUMBER IS 25
 DATA TAKEN 08125128 10-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CLW
0.11	0.042	0.2367	-0.012	-0.053	0.010	0.010
2.12	0.401	0.2439	-0.002	-0.295	0.018	0.023
4.13	0.798	0.2777	-0.039	-0.622	0.043	0.052
5.97	1.206	0.3346	-0.041	-1.001	0.077	0.082
7.91	1.723	0.4322	-0.107	-1.580	0.163	0.169
9.82	2.341	0.5907	-0.177	-2.330	0.285	0.293
11.92	3.076	0.8107	-0.267	-3.109	0.368	0.464
14.02	3.717	1.0731	-0.360	-4.010	0.439	0.430
15.94	4.404	1.3695	-0.460	-4.811	0.510	0.776
17.75	4.972	1.6744	-0.561	-5.517	0.576	0.970
19.80	5.714	2.1107	-0.695	-6.341	0.659	1.207
21.78	6.431	2.6019	-0.833	-7.086	0.293	1.764
23.86	7.076	3.1458	-0.965	-7.870	-0.075	1.861
25.77	7.673	3.6668	-1.040	-8.030	-0.115	2.300
27.96	8.202	4.2707	-1.163	-8.400	-0.293	2.611
29.70	8.575	4.7780	-1.164	-8.520	-1.700	3.069

Figure B.64. Computer Tabulated Force and Moment Data for Missile III
 33° Roll, Fin No. 3, Blunt Nose

RUN NUMBER IS 26
 DATA TAKEN 09109154 10-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CLW
0.27	0.078	0.2339	-0.054	-0.073	0.059	0.059
2.08	0.123	0.2308	-0.047	-0.270	0.055	0.057
4.04	0.758	0.2457	-0.054	-0.343	0.064	0.072
5.93	1.184	0.3228	-0.057	-0.711	0.069	0.084
7.98	1.715	0.4214	-0.061	-1.446	0.135	0.125
9.77	2.247	0.5312	-0.131	-1.992	0.194	0.191
11.68	2.832	0.7398	-0.190	-2.666	0.222	0.286
14.01	3.513	1.0067	-0.263	-3.419	0.171	0.430
15.97	4.093	1.2791	-0.340	-4.069	0.142	0.599
18.00	4.671	1.5892	-0.409	-4.714	0.038	0.832
20.11	5.279	1.9757	-0.501	-5.413	0.122	1.021
21.49	5.737	2.3105	-0.575	-5.939	-0.011	1.306
24.09	6.390	2.8488	-0.563	-6.594	0.001	1.072
25.79	6.792	3.2272	-0.565	-7.039	0.535	0.709
27.96	7.221	3.7385	-0.502	-7.474	0.507	1.080
29.48	7.529	4.1238	-0.705	-7.740	0.292	2.211

Figure B.65. Computer Tabulated Force and Moment Data for Missile III
 11° Roll, Fin No. 3, Pointed Nose

RUN NUMBER 18 27
 DATA TAKEN 08147151 18-JAN-82

COEFFICIENTS ABOUT THE WIND AXIS

ALPHA (DEG)	CL	CD	CC	CM	CNW	CLW
0.29	0.032	0.2403	0.001	-0.091	0.005	0.006
1.96	0.377	0.2307	-0.018	-0.294	0.015	0.017
4.17	0.780	0.2647	-0.025	-0.628	0.034	0.041
6.08	1.212	0.3220	-0.040	-1.006	0.070	0.082
7.86	1.621	0.4156	-0.054	-1.544	0.156	0.159
9.67	2.364	0.5814	-0.169	-2.305	0.272	0.288
11.92	3.059	0.7949	-0.261	-3.005	0.340	0.446
14.06	3.714	1.0447	-0.372	-3.843	0.387	0.625
16.20	4.473	1.4060	-0.489	-4.638	0.387	0.878
18.28	5.200	1.7933	-0.630	-5.420	0.373	1.169
19.84	5.740	2.1288	-0.742	-6.933	0.226	1.512
21.91	6.455	2.6328	-0.930	-6.613	-0.064	2.149
24.08	7.174	3.2046	-1.015	-7.032	-0.381	2.352
25.72	7.735	3.6883	-1.190	-7.374	-0.686	2.801
27.75	8.271	4.2725	-1.317	-7.604	-1.423	3.473
29.70	8.781	4.8896	-1.419	-7.663	-2.159	3.858

Figure B.66. Computer Tabulated Force and Moment Data for Missile III
 33° Roll, Fin No. 3, Pointed Nose

Appendix C
QUANTITATIVE FLOWFIELD MEASUREMENTS

Quantitative flowfield measurements were taken on the leeward side of both fineness ratio missiles (missiles of fineness ratio 8 and 16) using a 7-hole pressure probe described in section II-4. Tests were conducted in the subsonic wind tunnel at a free-stream velocity of 100 fps. All tests were conducted of missiles without fins and with the blunt nose.

The flowfield pressure measurements were taken in measurement planes perpendicular to the axis of the tunnel on the leeward side of the missile as shown in Figure C.01. Each measurement plane was approximately 4.5 inches wide by 4.5 inches in height. Pressure probe measurements were taken every 0.25 inches in a grid pattern within the mapping plane. Approximately 400 data measurements were taken within each mapping plane.

Most of the pressure measurements were taken in the aft plane with respect to the missile as shown in Figure C.01. The aft plane was approximately 0.1 inches aft of the missile and extended approximately 0.4 inches below the upper surface of the missile, which is shown in Figure C.02. However, several pressure measurements were also taken in mapping planes along the length of the missile body. These mapping planes included areas

along the sides of the missile approximately 0.1 inches from the missile surface outward as shown in Figure C.02.

Table C-1 summarizes the flowfield tests conducted on the 4 different cross-section shaped missiles of fineness ratio equal to 8. The table illustrates the various missile orientations tested and the locations of the flowfield mapping planes in which pressure data was recorded. Data was taken in the aft mapping plane for missiles at 15, 20, and 25 degrees pitch and 0, 11, 22, 33, and 45 degrees roll. Data was taken in the 2/3 aft plane (approximately 8 inches behind the nose-body junction) for missiles at 25 degrees pitch and 0, 11, 22, 33 and 45 degrees roll. In addition, pressures were measured in planes 0, 2, 4, 6, 8, 10, and 12 inches aft of the nose-body junction for the 20% corner radius missile at 25 degrees pitch and 22 degrees roll.

Table C-2 summarizes the flowfield tests conducted on the 5 different cross-section shaped missiles of fineness ratio equal to 16. Pressure data was measured in the aft mapping plane for missiles at 30 degrees pitch and 0 and 22 degrees roll. In addition, data was taken in the aft plane for the 20% corner radius missile at 30 degrees pitch and 11, 33, and 45 degrees roll.

Once the raw pressure data was obtained at each measurement point in the plane, the data was then reduced to two components of

velocity (v and w) in the crossflow. The velocity crossflow measurements were plotted as a series of vectors originating at the respective points in the measurement grid, the length of each velocity vector being proportional to the magnitude of the crossflow velocity at that point. These plots were useful in visualizing vortices and their approximate locations relative to the missile. Velocity crossflow plots are shown in Figures C-1 through C-16 for the various missile configurations and orientations tested.

A nondimensional coefficient of total pressure, C_{Total} , was also calculated at each grid point and was the primary parameter used to analyze the flowfields. C_{Total} is the difference between the local total pressure (P_{oLocal}) at the measurement point and the overall tunnel total pressure ($P_{oTunnel}$) nondimensionalized by the tunnel dynamic pressure ($P_{oTunnel} - P_{sTunnel}$), where $P_{sTunnel}$ is the tunnel static pressure:

$$C_{Total} = \frac{P_{oLocal} - P_{sTunnel}}{P_{oTunnel} - P_{sTunnel}}$$

C_{Total} is negatively related to vortex strength, since a stronger vortex causes more viscous losses, resulting in a lower C_{Total} . Because a vortex is strongest at its center, C_{Total} will be most negative near the vortex center. Thus, by comparing C_{Total} measurements for various missile configurations, one can determine

which missile configurations have stronger vortices and the positions of these vortices relative to the missile body. A computer program was used to plot constant C_{Total} contours in each measurement plane. Figures C-1 through C-16 show these C_{Total} contours and the values of C_{Total} at the center of vortices in the measurement planes for the various missile configurations and orientations tested.

By comparing the crossflow velocity vectors and total pressure contours in Figures C-1 rough C-16 for the various missile configurations and orientations tested, trends can be observed on how various parameters affect the flowfield. The data essentially illustrates how pitch angle, roll angle, body corner radius, nose shape, and fineness ratio affect the flowfield. In addition, the data (Figures 9 and 10) also illustrates how the flow changes along the axial length of the missile body. For a detailed analysis on how each of these parameters affect the flowfield, refer to references 9 and 10.

One final observation should be pointed out when comparing the flowfield data in Figures C-1 through C-16. Figures C-1 through C-8 and C-14 through C-16 are plotted looking upstream (view looking at aft end of missile). Figures C-9 through C-13 are plotted looking downstream (view looking at front of missile). Therefore, to compare, for example, Figures C-8 and C-13 one must take the mirror image of Figure C-8 and compare that to Figure C-13.

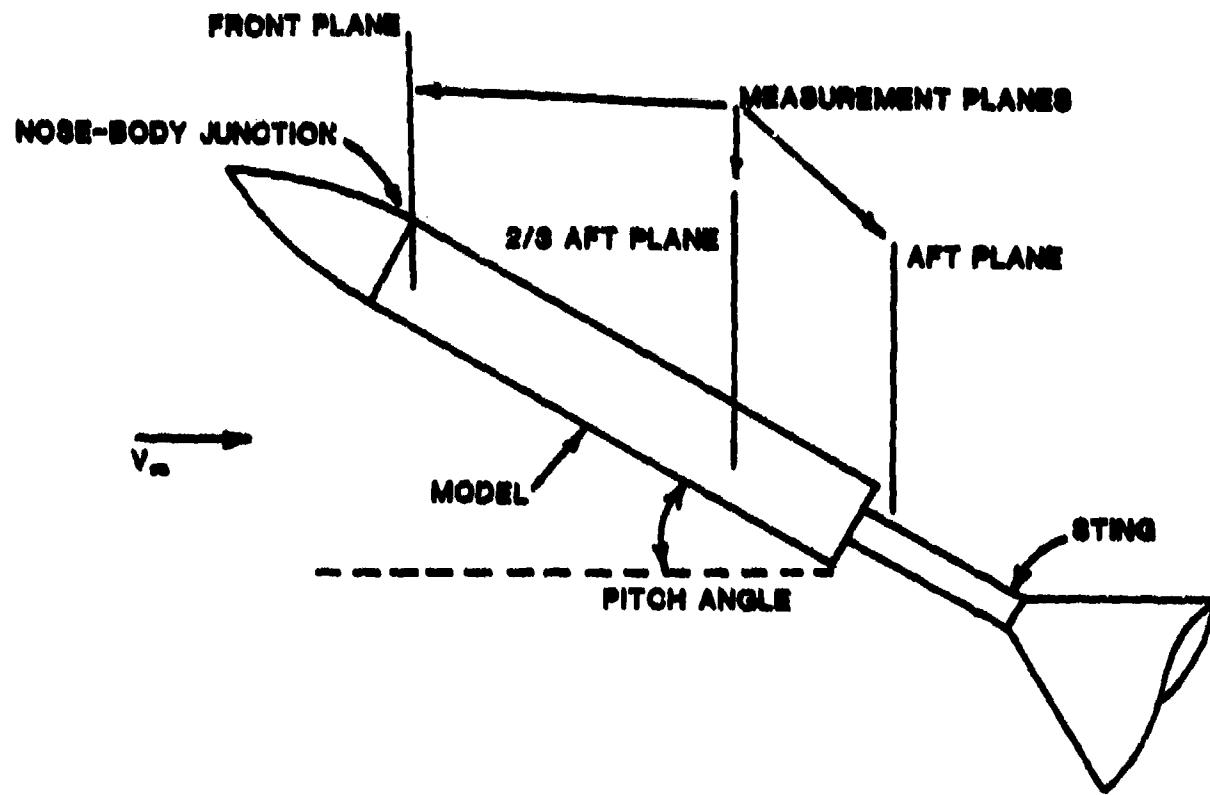


Figure C.01 Flowfield Measurement Planes

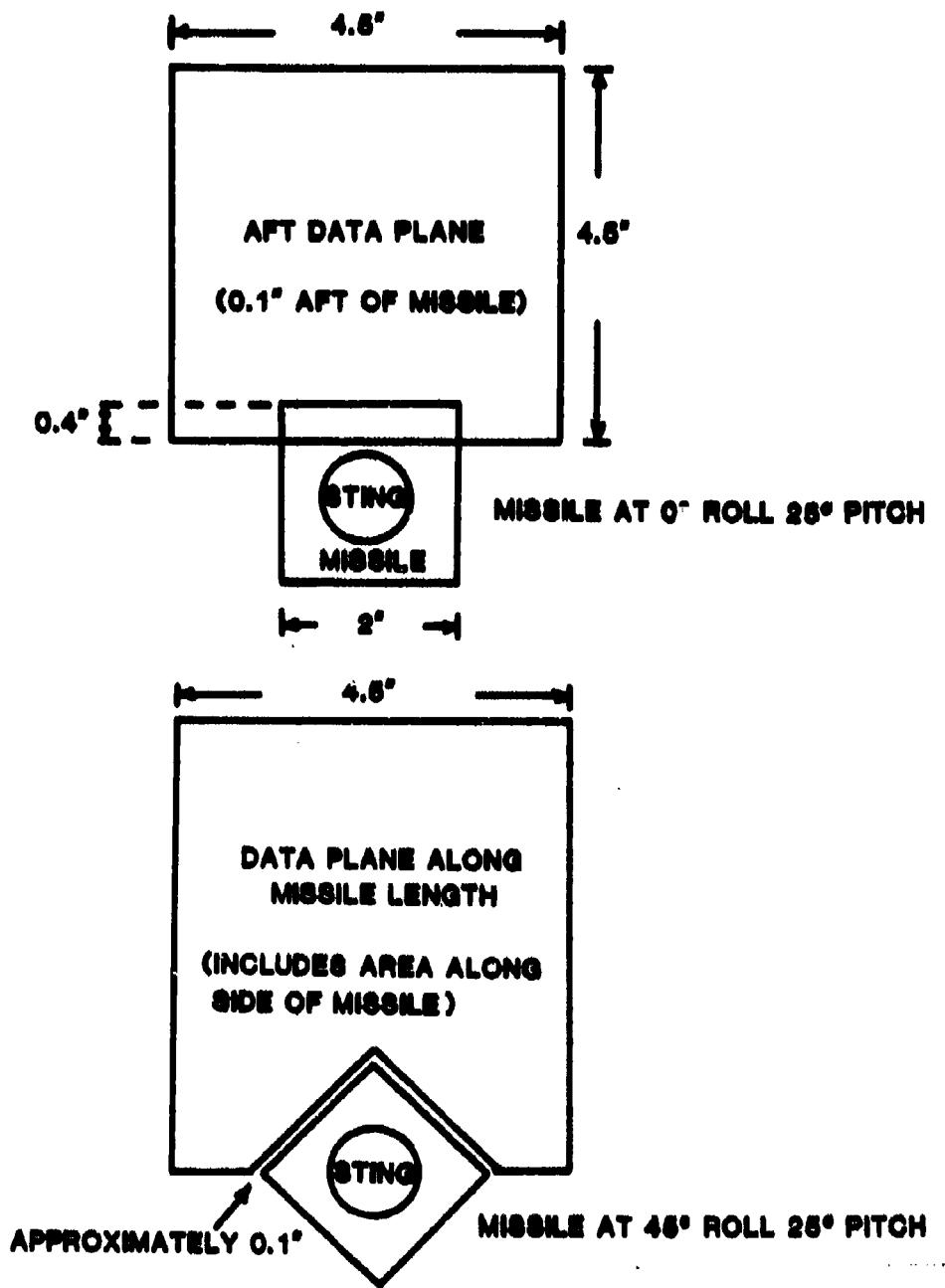


Figure C.02 Data Measurement Planes Aft of Missile and along Missile. View is Looking Upstream (at Aft End of Missile)

TABLE C-1
QUANTITATIVE FLOWFIELD TESTS
(Missiles of Fineness Ratio Equal to 8)

MISSILE ^{**} BODY	ROLL ANGLE	ANGLE OF ATTACK	LOCATION ^{***} OF DATA PLANE	VIEWS OF DATA PLANE (looking -)	FIGURE
I, II, III	11° & 33°	15°	Aft of missile	Upstream	C-1
I, II, III, IV	9°	20°	Aft of missile	Upstream	C-2
I, II, III	11° & 22°	20°	Aft of missile	Upstream	C-3
I, II, III	33° & 45°	20°	Aft of missile	Upstream	C-4
I, II, III, IIIIP*, IV	0°	25°	Aft of missile	Upstream	C-4
I, II, III, IIIIP*	22°	25°	Aft of missile	Upstream	C-6
I, II, III, IIIIP*	45°	25°	Aft of missile	Upstream	C-7
I, II, III	11° & 33°	25°	Aft of missile	Upstream	C-8
I	22°	0, 2, 4, 86 inches aft of body-nose connection	Downstream	Downstream	C-9
I	22°	25°	8, 10, 12 inches aft of body-nose connection	Downstream	C-10
I	0°, 11°, 22°, 33° & 45°	25°	8 inches aft of body-nose connection (2/3 aft plane)	Downstream	C-11
II	0°, 11°, 22°, 33°, & 45°	25°	8 inches aft of body-nose connection (2/3 aft plane)	Downstream	C-12
III	0°, 11°, 22°, 33°, & 45°	25°	8 inches aft of body-nose connection (2/3 aft plane)	Downstream	C-13

*Denotes body with pointed nose

**Body Configurations

I - Square

II - 10% Corner Radius

III - 20% Corner Radius

IV - Round

***See Figure C-01 for location of data planes.

TABLE C-2

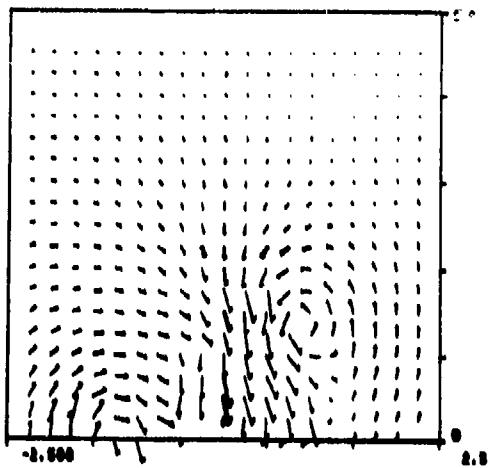
QUANTITATIVE FLOWFIELD TESTS
(Missiles of Fineness Ratio Equal to 16)

MISSILE * BODY	ROLL ANGLE	ANGLE OF ATTACK	LOCATION ** OF DATA PLANE	VIEW OF DATA PLANE (LOOKING -)	FIGURE
1,2,3,4,5	0°	30°	Aft of Missile	Upstream	C-14
1,2,3,4,5	22°	30°	Aft of Missile	Upstream	C-15
3	0°,11°,22°,33°,45°	30°	Aft of Missile	Upstream	C-16

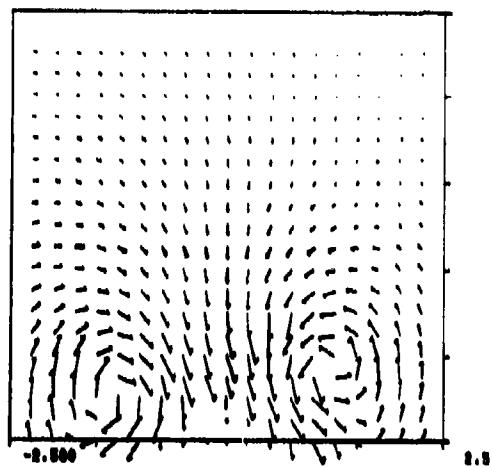
*Body Configurations

- 1 - Square
- 2 - 10% Corner Radius
- 3 - 20% Corner Radius
- 4 - 30% Corner Radius
- 5 - Round

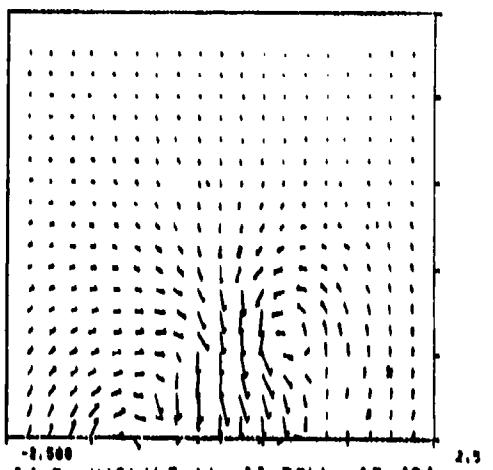
**See Figure C.01 for location of aft data plane.



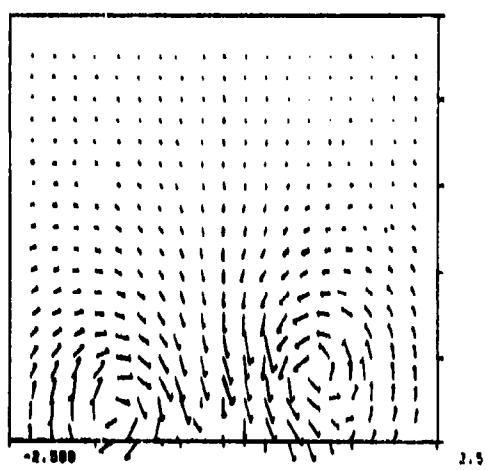
1A-1. MISSILE 1, 11 ROLL, 15 AOA.



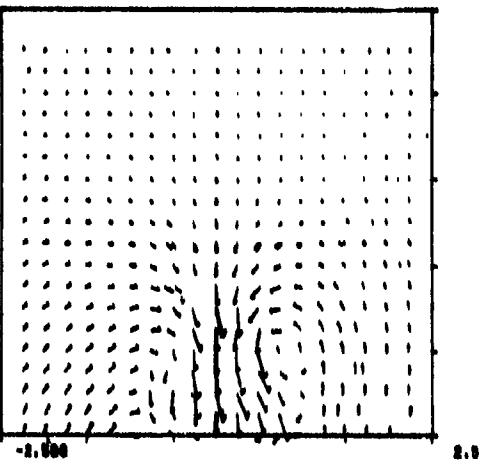
1A-4. MISSILE 1, 33 ROLL, 15 AOA.



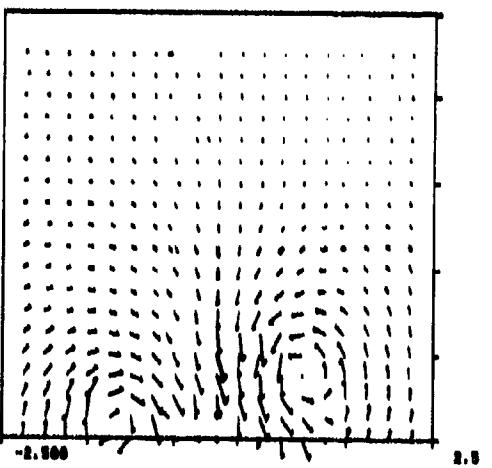
1A-2. MISSILE II, 11 ROLL, 15 AOA.



1A-5. MISSILE II, 33 ROLL, 15 AOA.



1A-3. MISSILE III, 11 ROLL, 15 AOA.



1A-6. MISSILE III, 33 ROLL, 15 AOA.

FIGURE C-1A. VELOCITY VECTOR FLOWFIELD PROFILES.
AFT PLANE, VIEW LOOKING UPSTREAM.

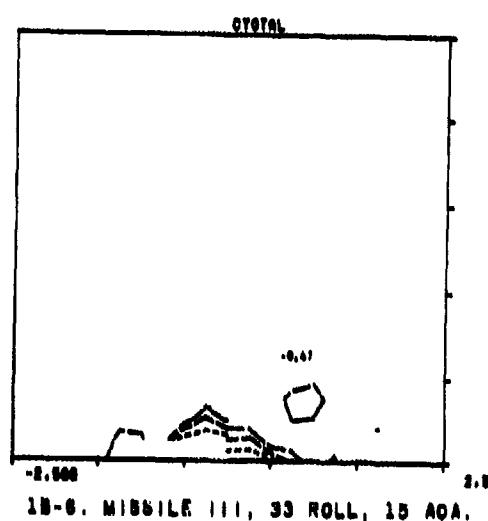
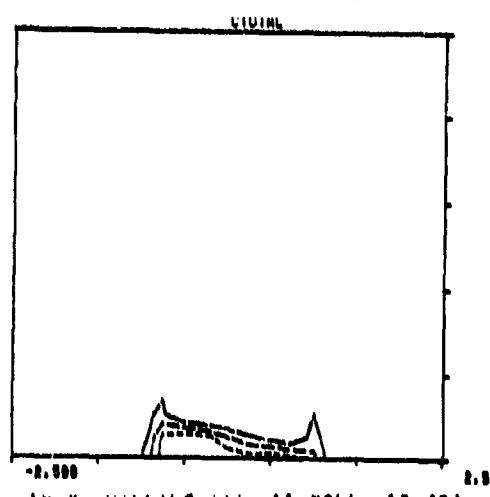
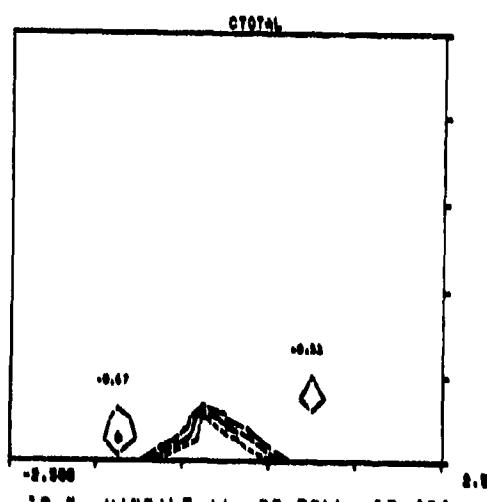
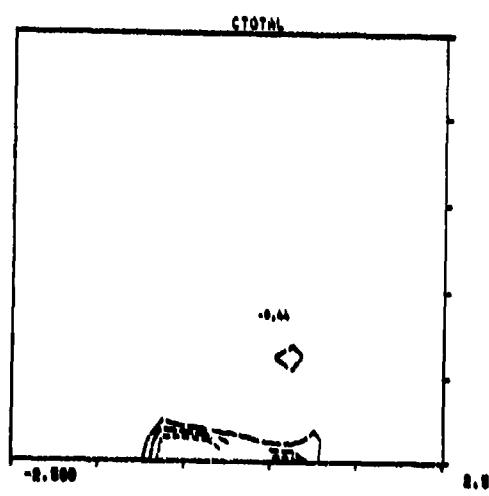
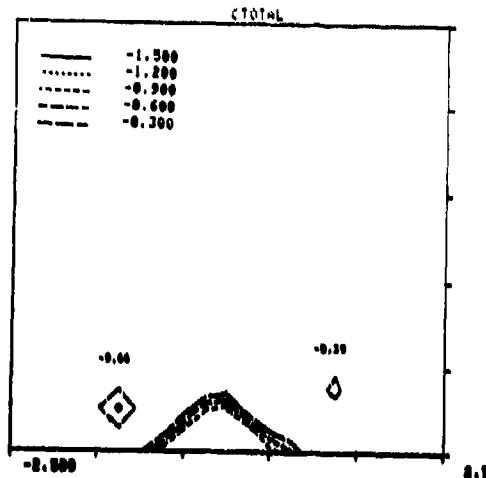
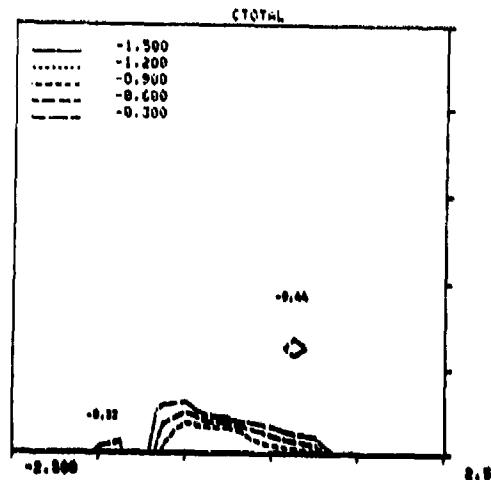
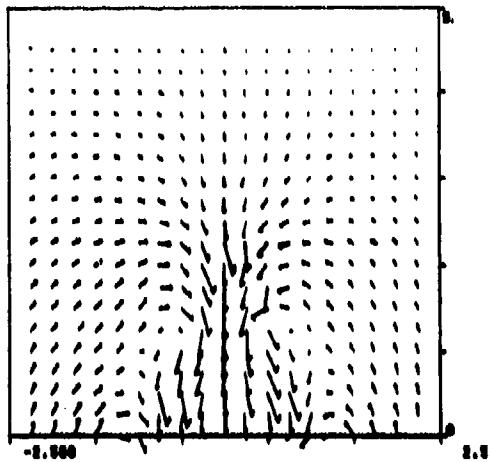
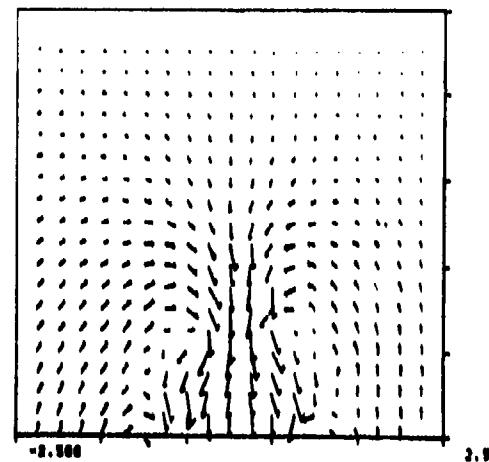


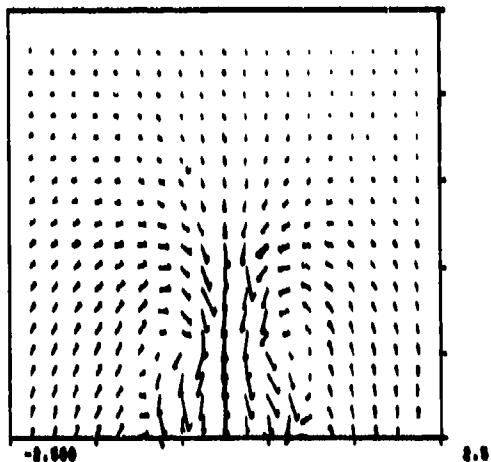
FIGURE C-1A. PRESSURE CONTOUR FLOWFIELD PROFILES.
AFT PLANE, VIEW LOOKING UPSTREAM.



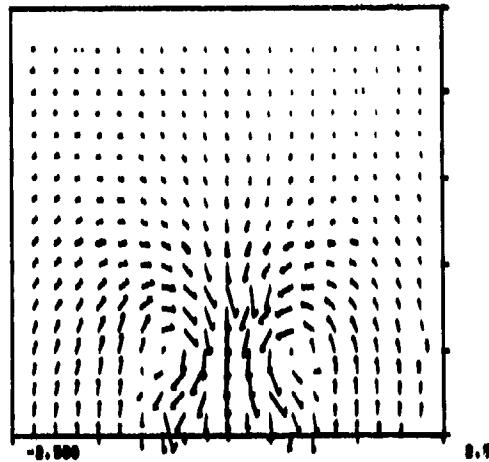
2A-1. MISSILE I, 0 ROLL, 20 AOA.



2A-2. MISSILE II, 0 ROLL, 20 AOA.

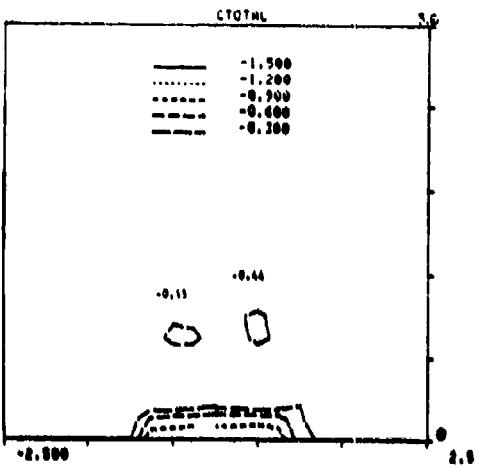


2A-3. MISSILE III, 0 ROLL, 20 AOA.

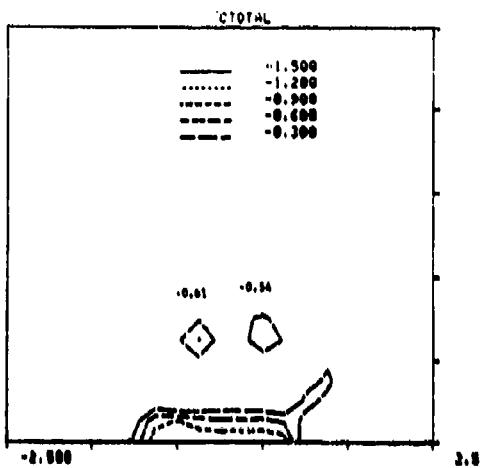


2A-4. MISSILE IV, 0 ROLL, 20 AOA.

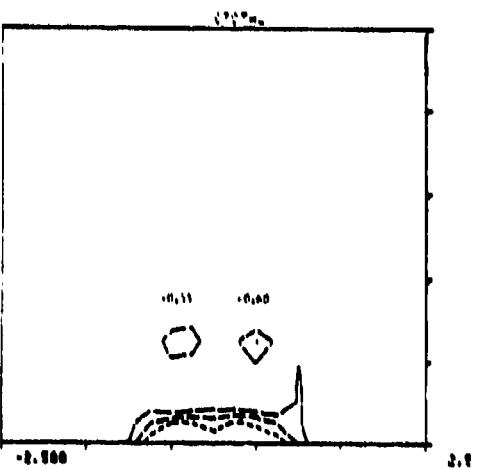
FIGURE C-2A. VELOCITY VECTOR FLOWFIELD PROFILES.
AFT PLANE, VIEW LOOKING UPSTREAM.



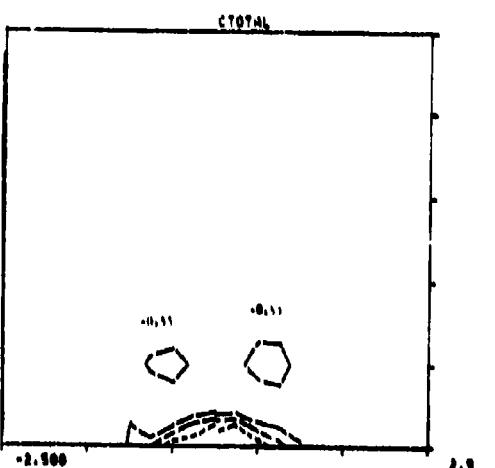
2B-1. MISSILE I, 3 ROLL, 20 AOA.



2B-2. MISSILE II, 0 ROLL, 20 AOA.

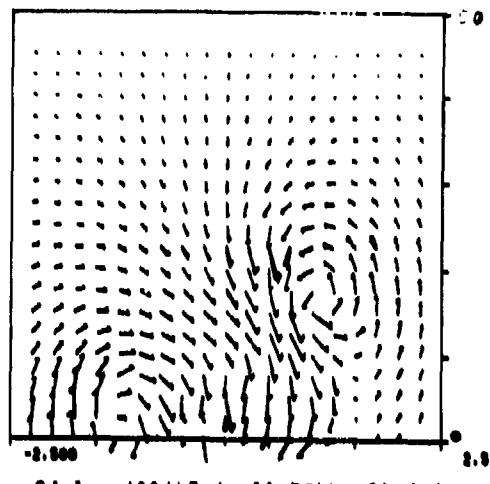


2B-3. MISSILE III, 0 ROLL, 20 AOA.

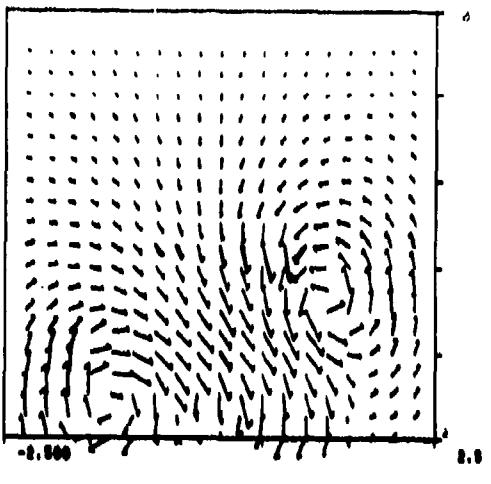


2B-4. MISSILE IV, 0 ROLL, 20 AOA.

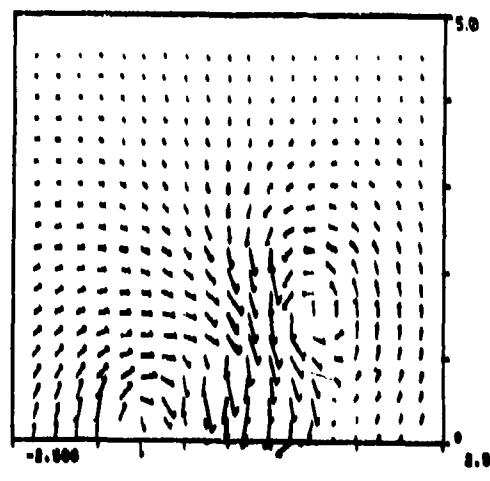
FIGURE C-2B. PRESSURE CONTOUR FLOWFIELD PROFILES.
AFT PLANE, VIEW LOOKING UPSTREAM.



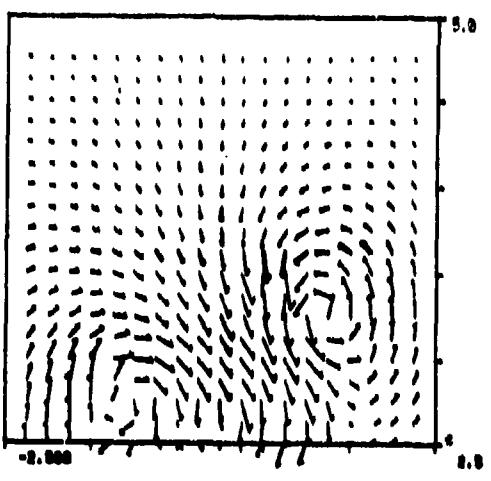
3A-1. MISSILE I, 21 ROLL, 20 AOA



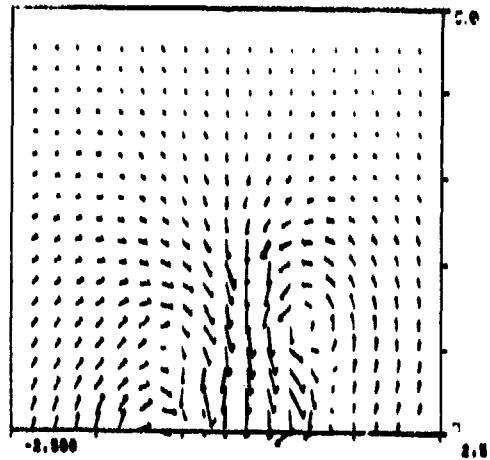
3A-4. MISSILE I, 22 ROLL, 20 AOA



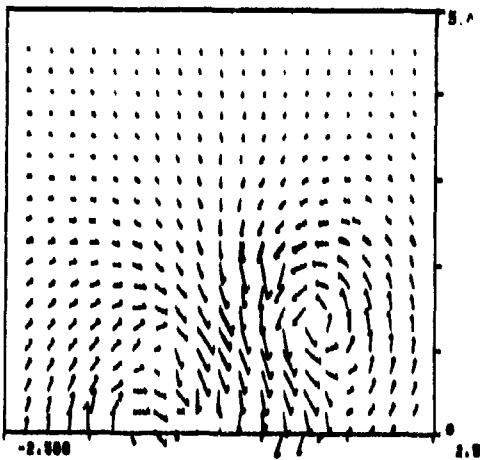
3A-2. MISSILE II, 21 ROLL, 20 AOA



3A-5. MISSILE II, 22 ROLL, 20 AOA

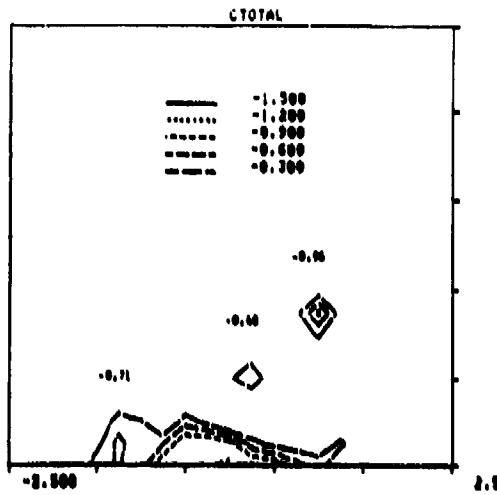


3A-3. MISSILE III, 21 ROLL, 20 AOA

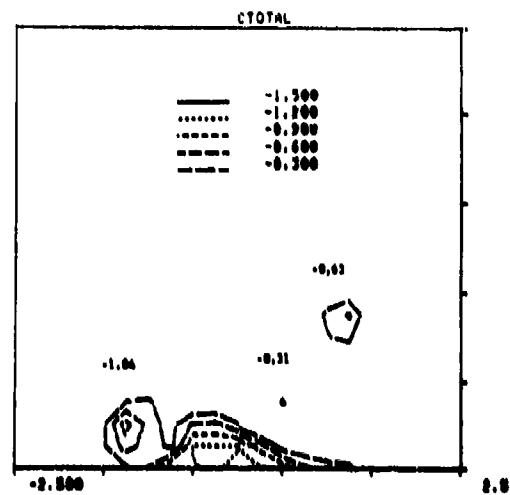


3A-6. MISSILE III, 22 ROLL, 20 AOA

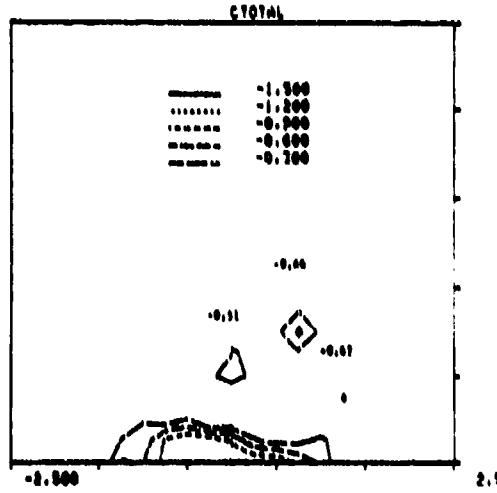
FIGURE C-3A. VELOCITY VECTOR FLOWFIELD PROFILES.
AFT PLANE, VIEW LOOKING UPSTREAM.



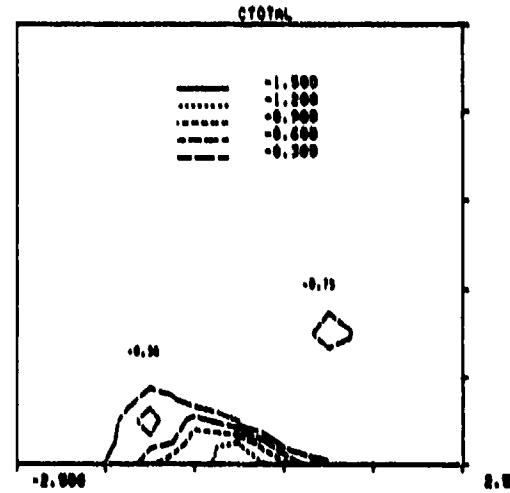
3B-1. MISSILE I, 11 ROLL, 20 AOA



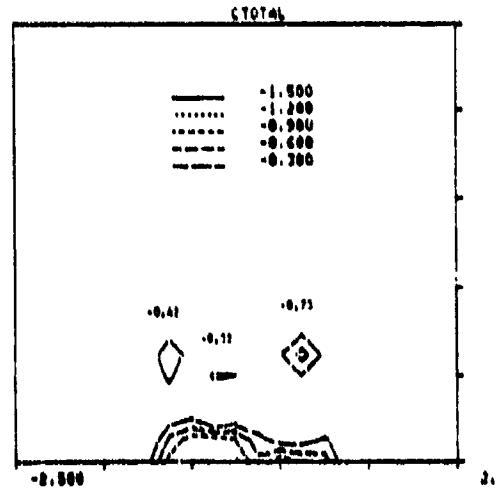
3B-4. MISSILE I, 22 ROLL, 20 AOA



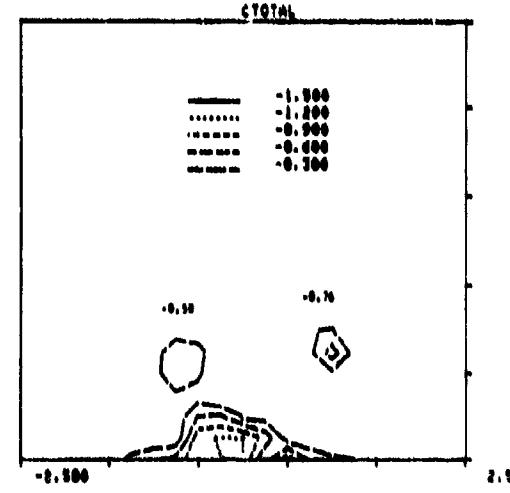
3B-2. MISSILE II, 11 ROLL, 20 AOA



3B-5. MISSILE II, 22 ROLL, 20 AOA



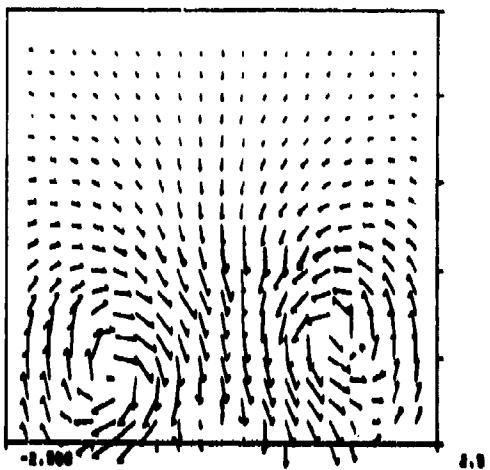
3B-3. MISSILE III, 11 ROLL, 20 AOA



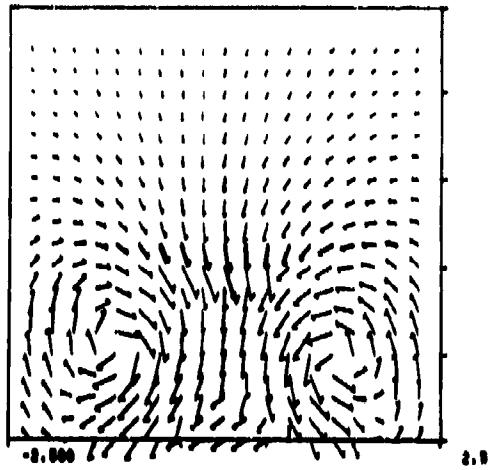
3B-6. MISSILE III, 22 ROLL, 20 AOA

FIGURE C-3B. PRESSURE CONTOUR FLOWFIELD PROFILES.

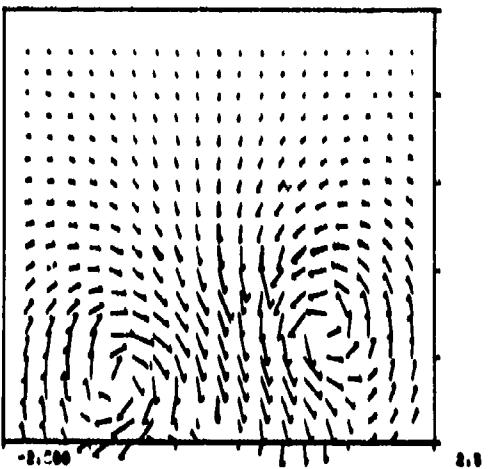
AFT PLANE, VIEW LOOKING UPSTREAM.



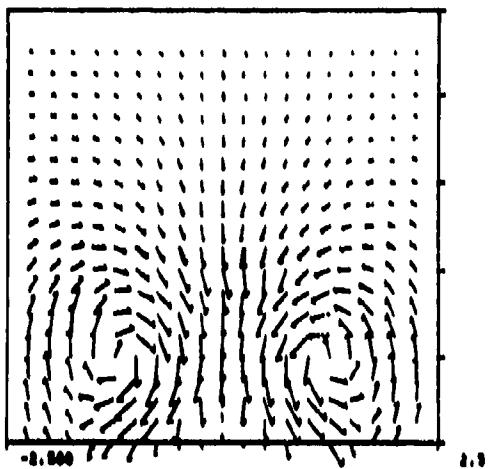
4A-1. MISSILE I, 33 ROLL, 20 AOA.



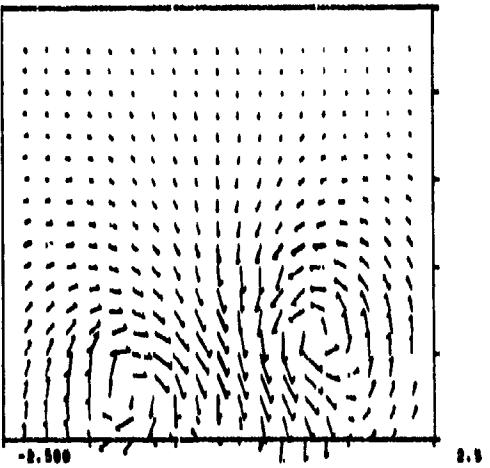
4A-4. MISSILE I, 45 ROLL, 20 AOA.



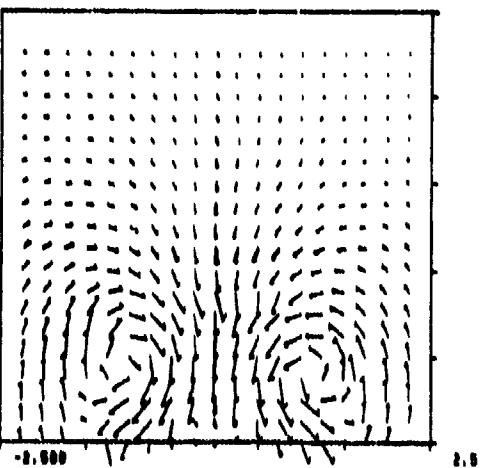
4A-2. MISSILE II, 33 ROLL, 20 AOA.



4A-5. MISSILE II, 45 ROLL, 20 AOA.



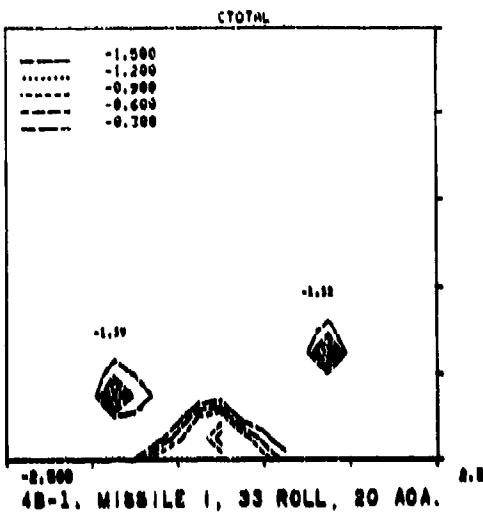
4A-3. MISSILE III, 33 ROLL, 20 AOA.



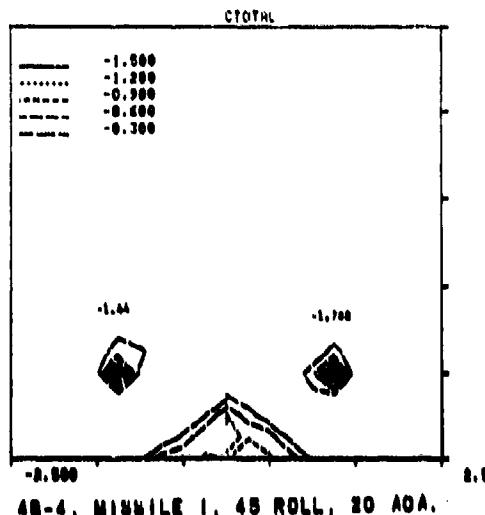
4A-6. MISSILE III, 45 ROLL, 20 AOA.

FIGURE C-4A. VELOCITY VECTOR FLOWFIELD PROFILES.

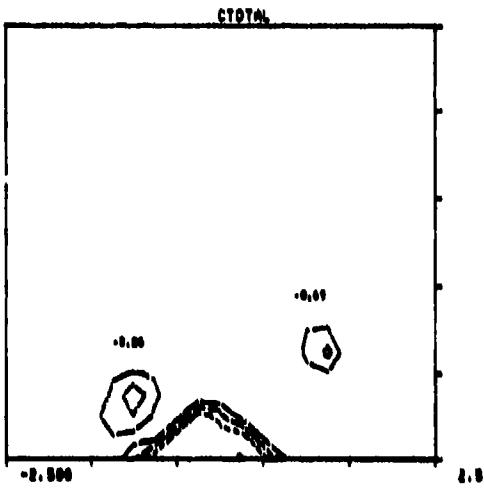
AFT PLANE, VIEW LOOKING UPSTREAM.



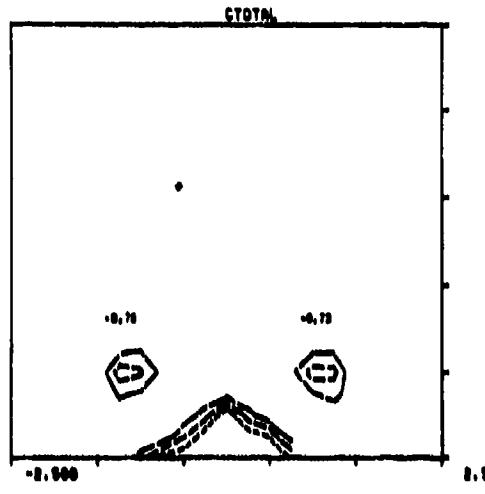
4B-1. MISSILE I, 33 ROLL, 20 AOA.



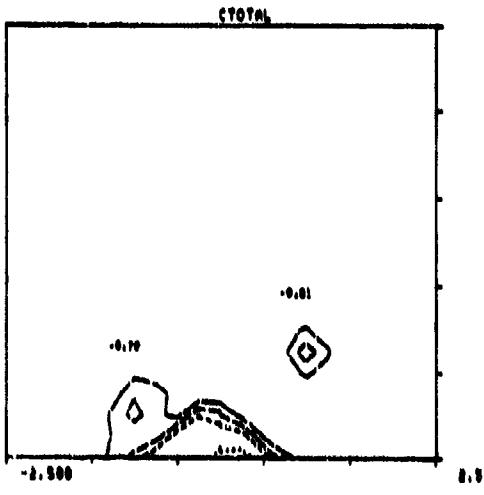
4B-4. MISSILE I, 45 ROLL, 20 AOA.



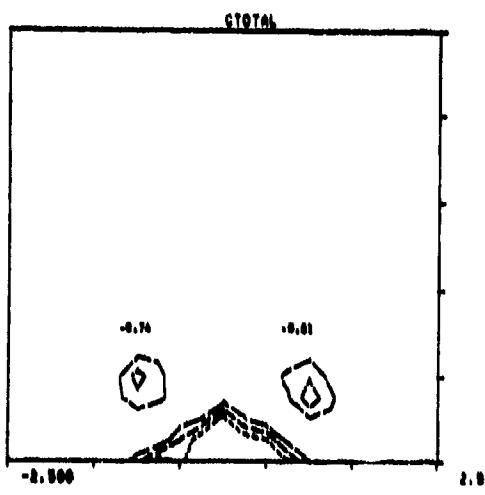
4B-2. MISSILE II, 33 ROLL, 20 AOA.



4B-5. MISSILE II, 45 ROLL, 20 AOA.



4B-3. MISSILE III, 33 ROLL, 20 AOA.



4B-6. MISSILE III, 45 ROLL, 20 AOA.

FIGURE C-4B. PRESSURE CONTOUR FLOWFIELD PROFILES.
AFT PLANE, VIEW LOOKING UPSTREAM.

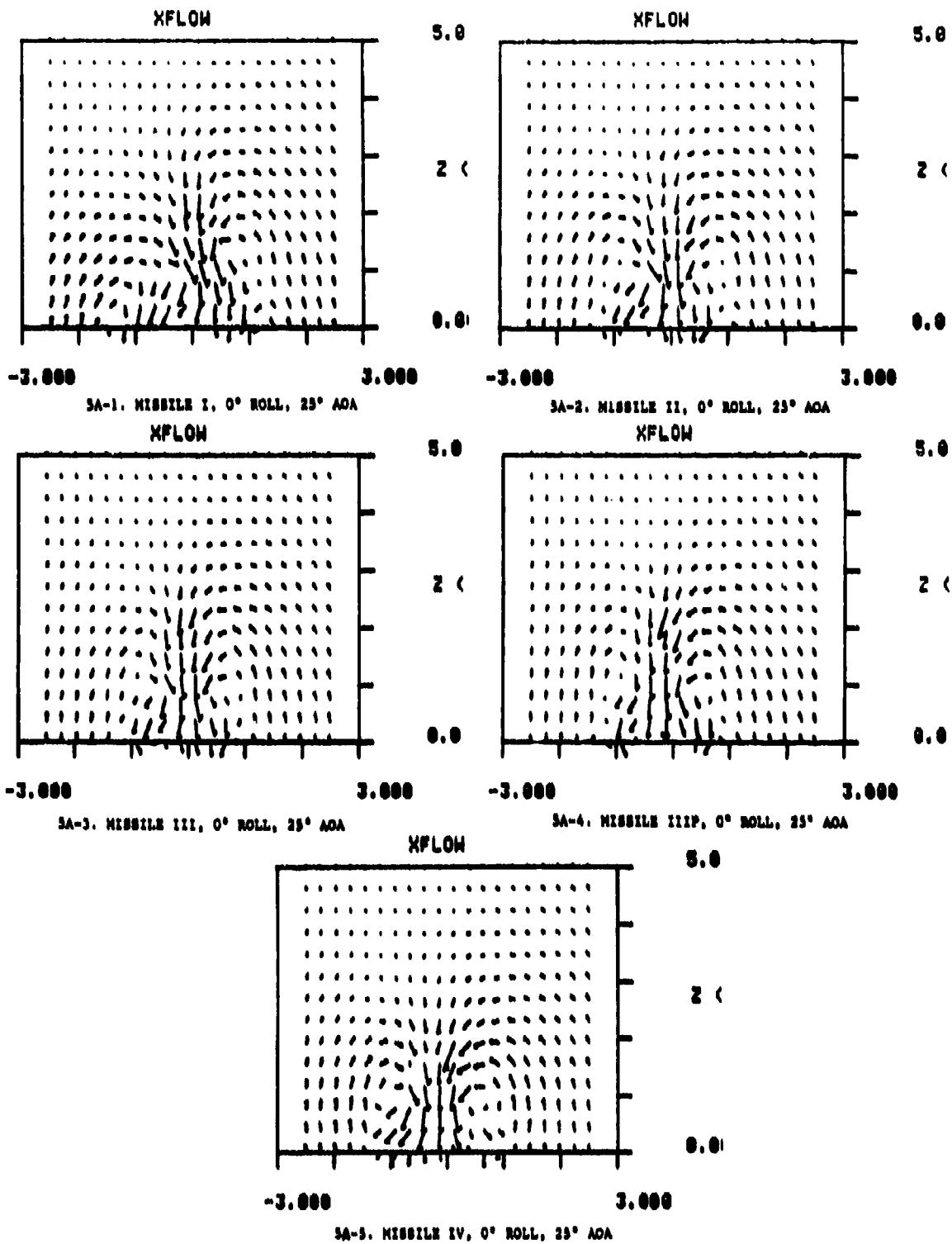
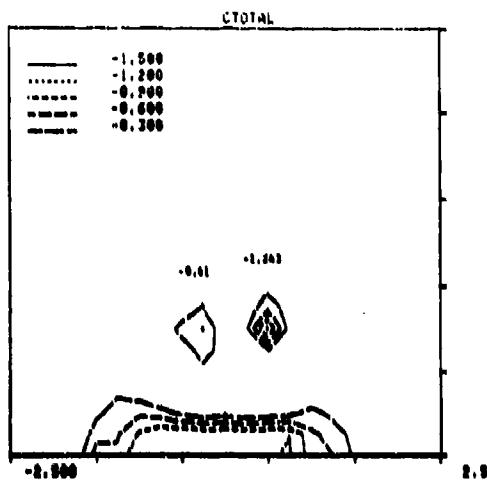
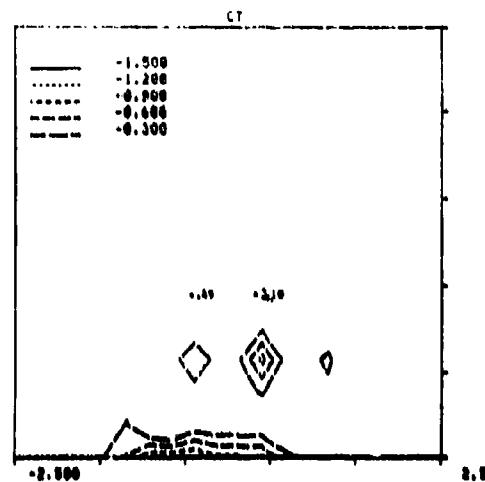


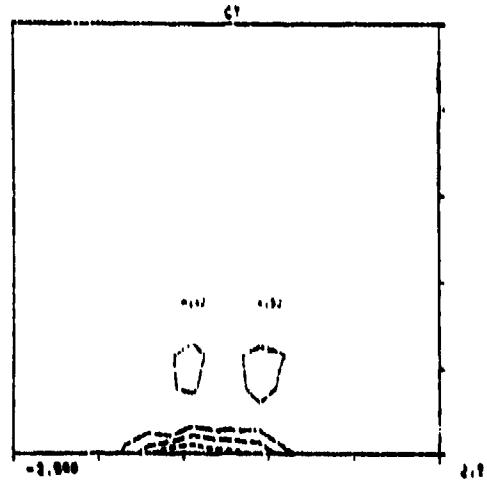
FIGURE C-5A. VELOCITY VECTOR FLOWFIELD PROFILES.
AFT PLANE, VIEW LOOKING UPSTREAM.



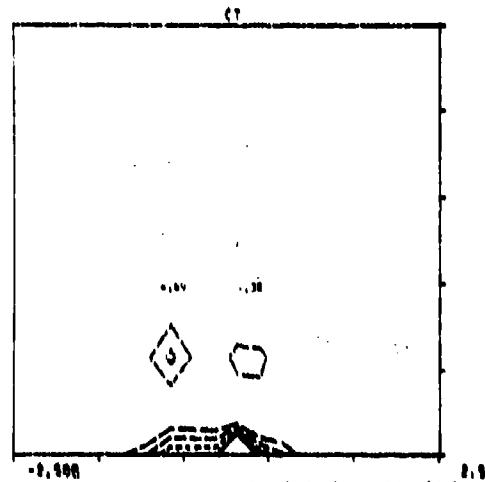
5B-1. MISSILE I, 0 ROLL, 25 AOA.



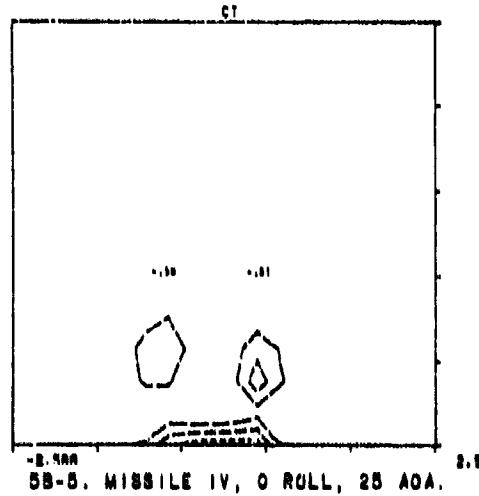
5B-2. MISSILE II, 0 ROLL, 25 AOA.



5B-3. MISSILE III, 0 ROLL, 25 AOA.



5B-4. MISSILE IIIIP, 0 ROLL, 25 AOA.



5B-5. MISSILE IV, 0 ROLL, 25 AOA.

FIGURE C-5B. PRESSURE CONTOUR FLOWFIELD PROFILES.
AFT PLANE, VIEW LOOKING UPSTREAM.

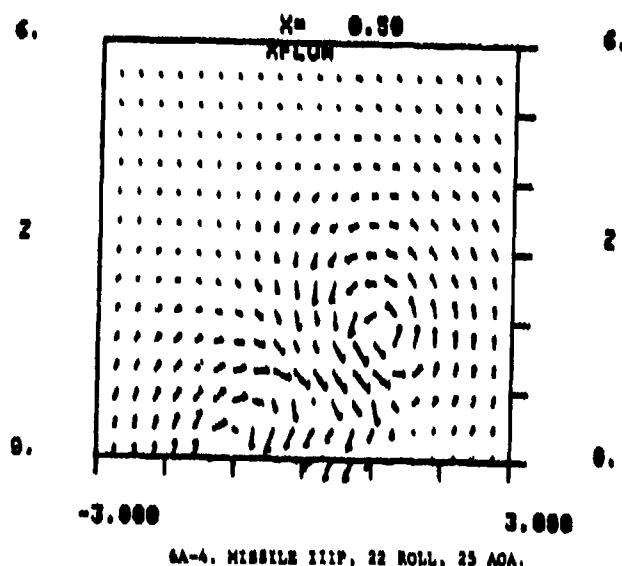
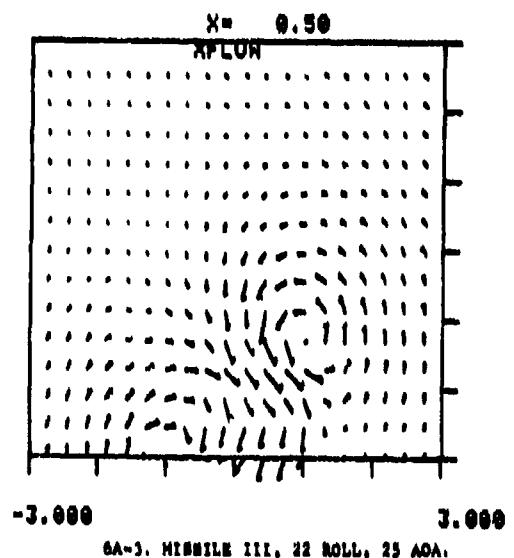
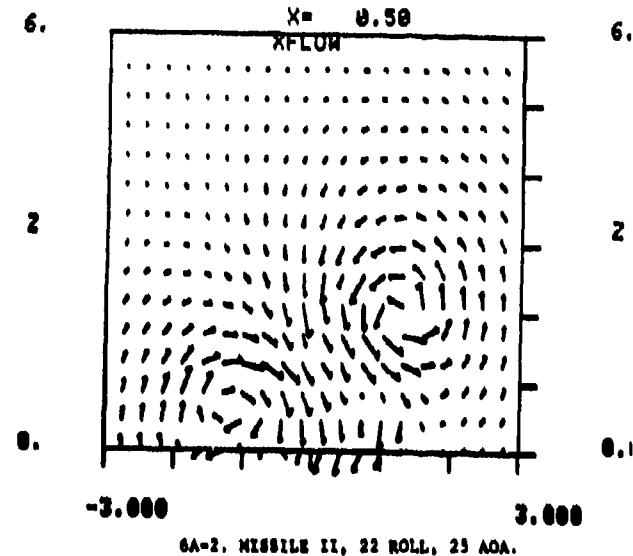
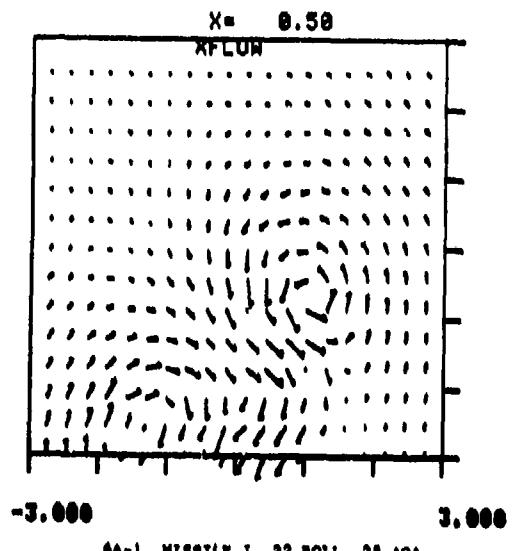
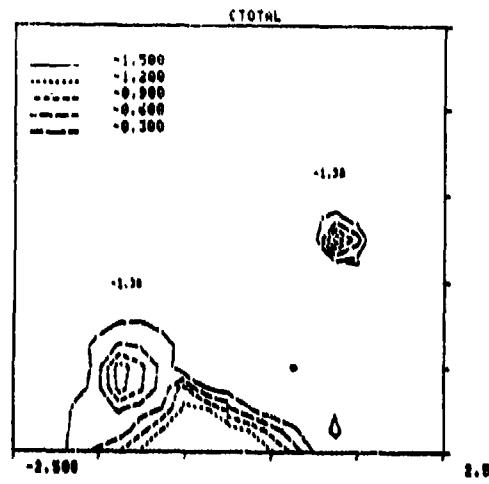
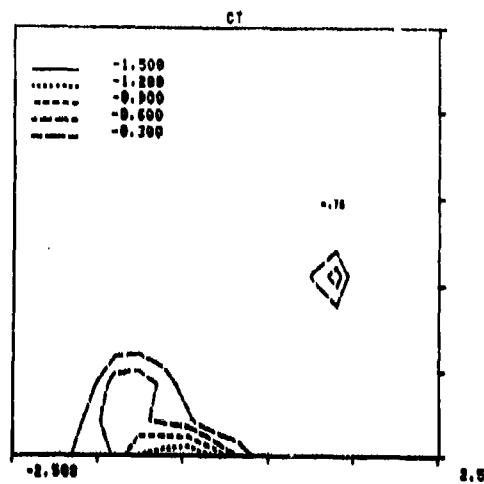


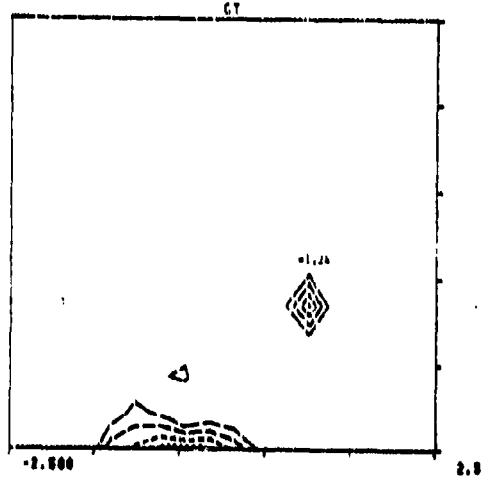
FIGURE C-6A. VELOCITY VECTOR FLOWFIELD PROFILES.
AFT PLANE, VIEW LOOKING UPSTREAM.



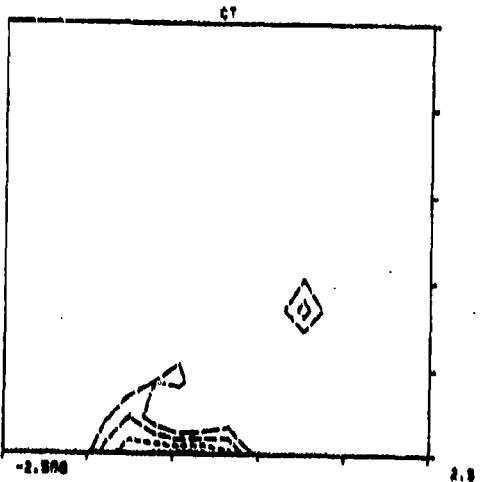
BB-1. MISSILE 1, 22 ROLL, 25 AOA.



BB-2. MISSILE 11, 22 ROLL, 25 AOA.



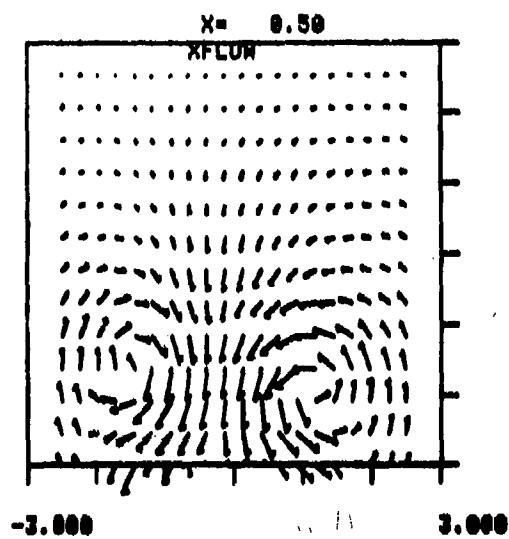
BB-3. MISSILE 111, 22 ROLL, 25 AOA.



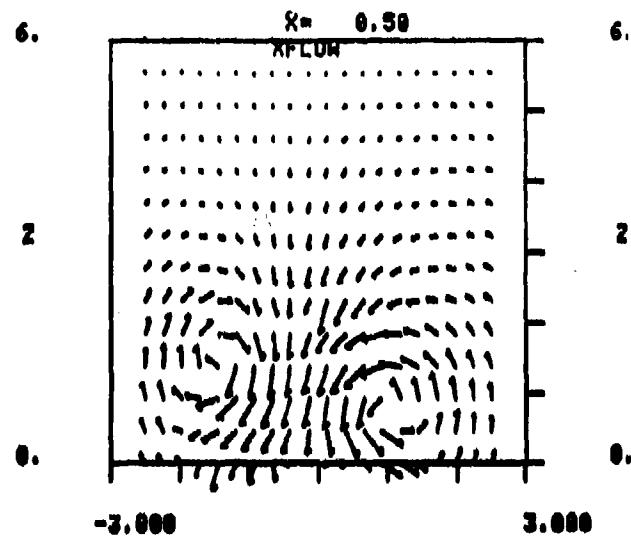
BB-4. MISSILE 111P, 22 ROLL, 25 AOA.

FIGURE C-6B. PRESSURE CONTOUR FLOWFIELD PROFILES.

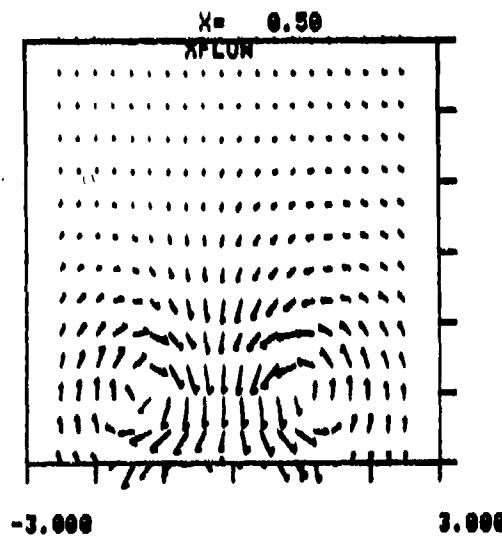
AFT PLANE, VIEW LOOKING UPSTREAM.



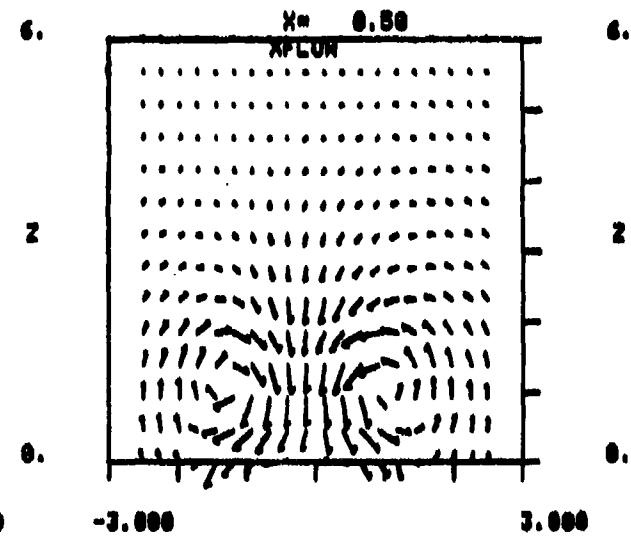
7A-1. MISSILE I, 45 ROLL, 25 AOA.



7A-2. MISSILE II, 45 ROLL, 25 AOA.

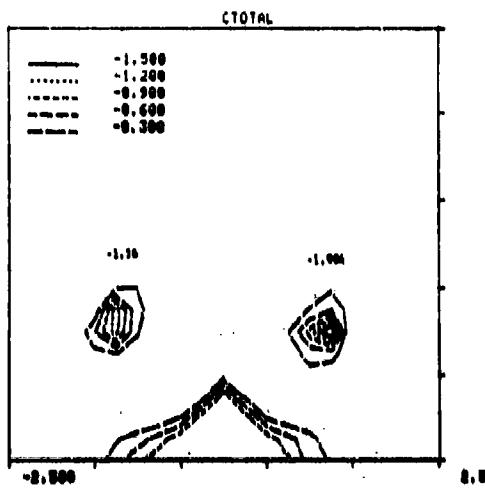


7A-3. MISSILE III, 45 ROLL, 25 AOA.

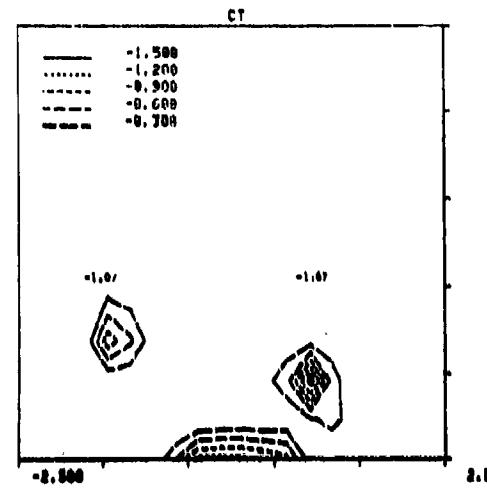


7A-4. MISSILE IIIIP, 45 ROLL, 25 AOA.

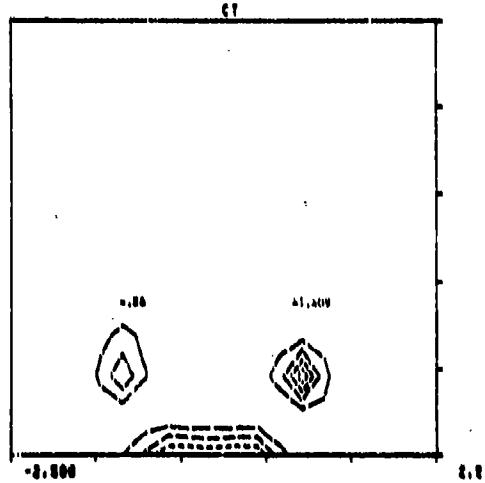
FIGURE C-7A. VELOCITY VECTOR FLOWFIELD PROFILES.
AFT PLANE, VIEW LOOKING UPSTREAM.



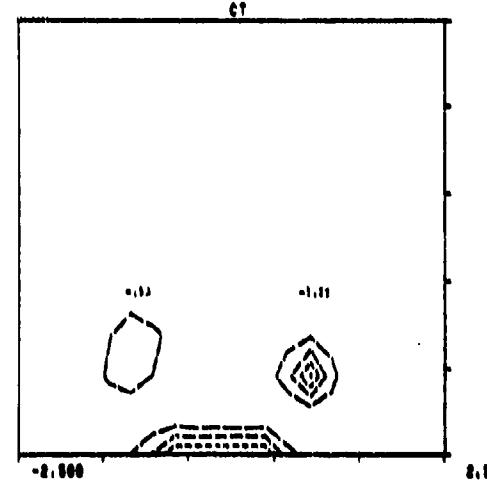
7B-1. MISSILE I, 45 ROLL, 25 AOA.



7B-2. MISSILE II, 45 ROLL, 25 AOA.



7B-3. MISSILE III, 45 ROLL, 25 AOA.



7B-4. MISSILE IIIp, 45 ROLL, 25 AOA.

FIGURE C-7B. PRESSURE CONTOUR FLOWFIELD PROFILES.

AFT PLANE, VIEW LOOKING UPSTREAM.

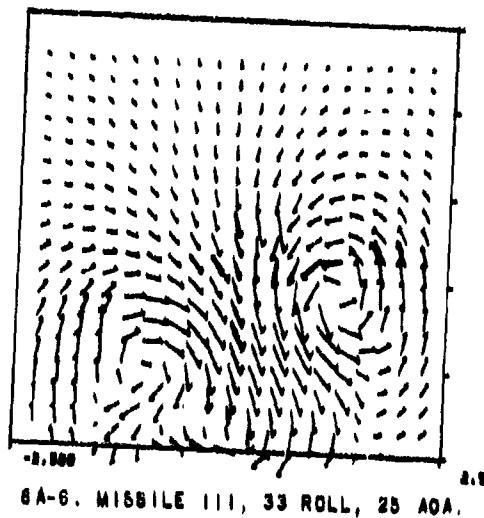
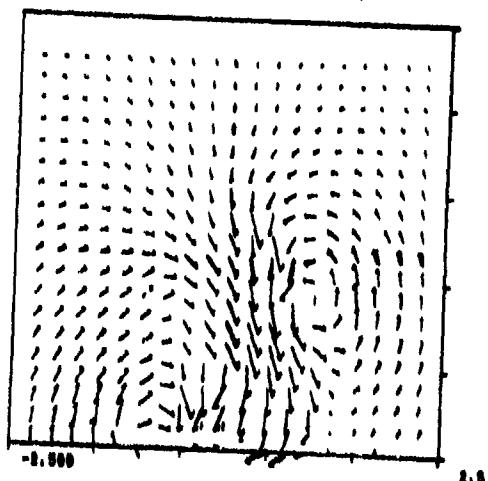
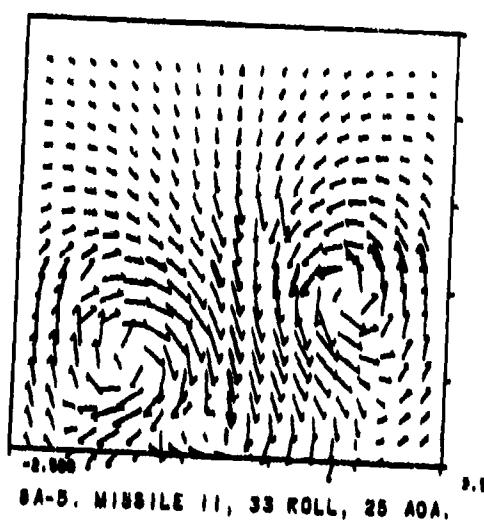
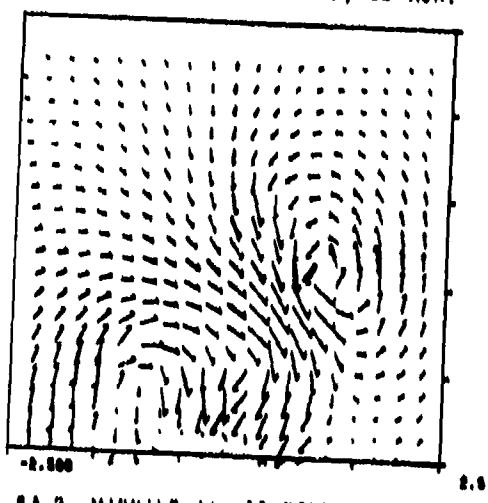
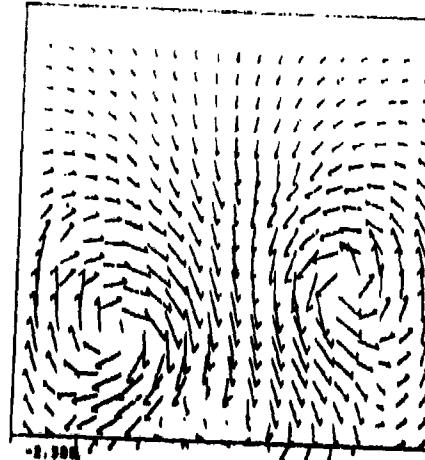
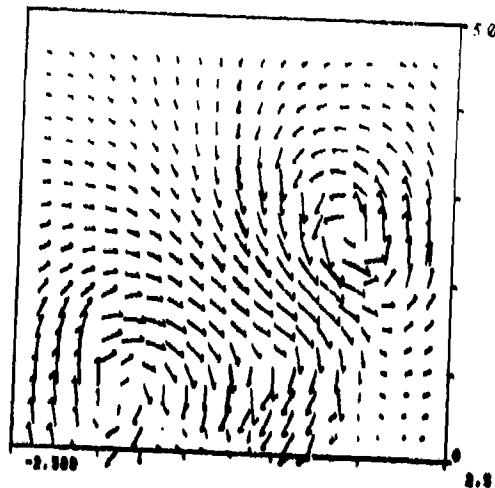
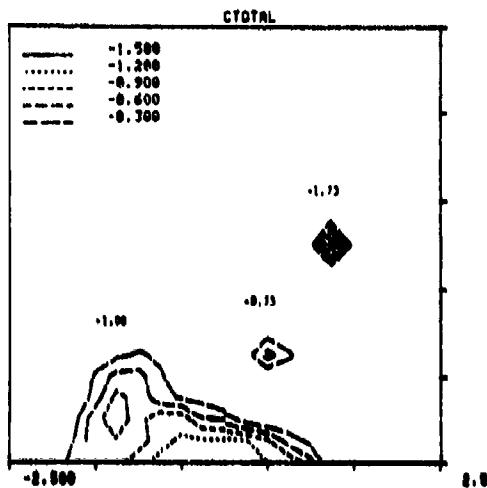
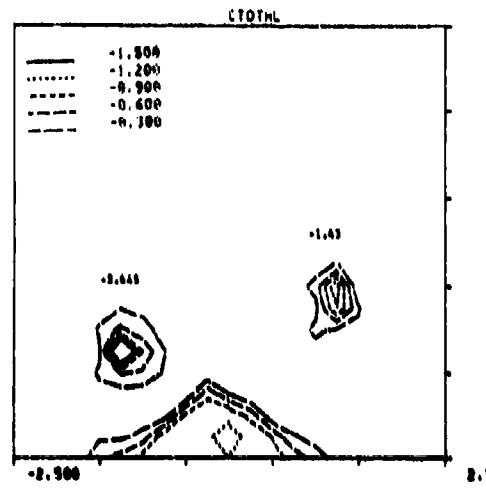


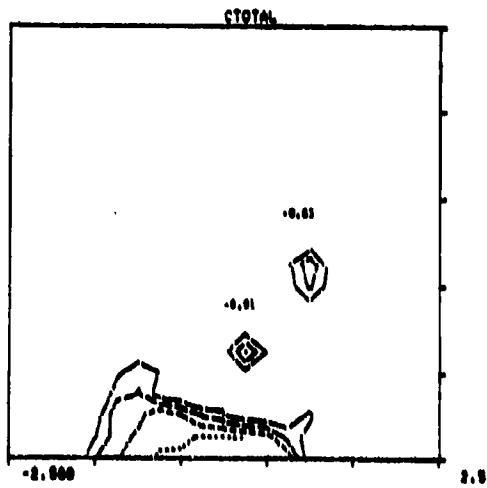
FIGURE C-8A. VELOCITY VECTOR FLOWFIELD PROFILES.
AFT PLANE, VIEW LOOKING UPSTREAM.



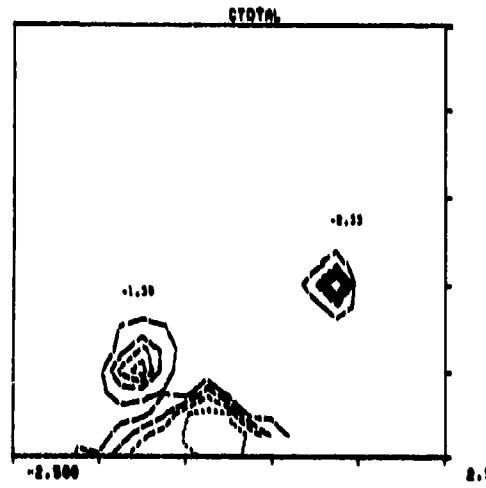
8B-1. MISSILE I, 11 ROLL, 25 AOA.



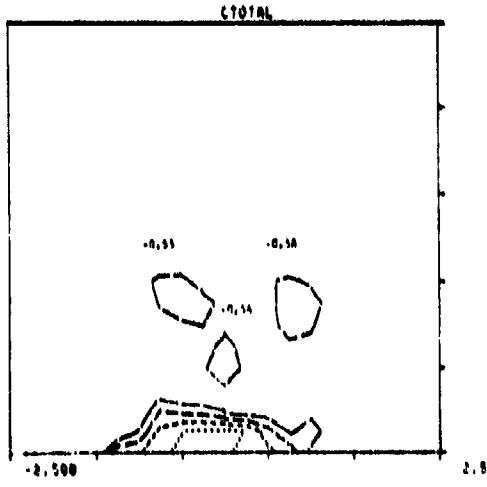
8B-4. MISSILE I, 33 ROLL, 25 AOA.



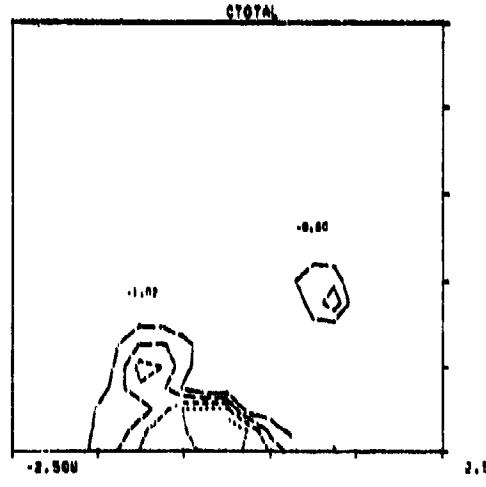
8B-2. MISSILE II, 11 ROLL, 25 AOA.



8B-5. MISSILE II, 33 ROLL, 25 AOA.



8B-3. MISSILE III, 11 ROLL, 25 AOA.



8B-6. MISSILE III, 33 ROLL, 25 AOA.

FIGURE C-8B. PRESSURE CONTOUR FLOWFIELD PROFILES.
AFT PLANE, VIEW LOOKING UPSTREAM.

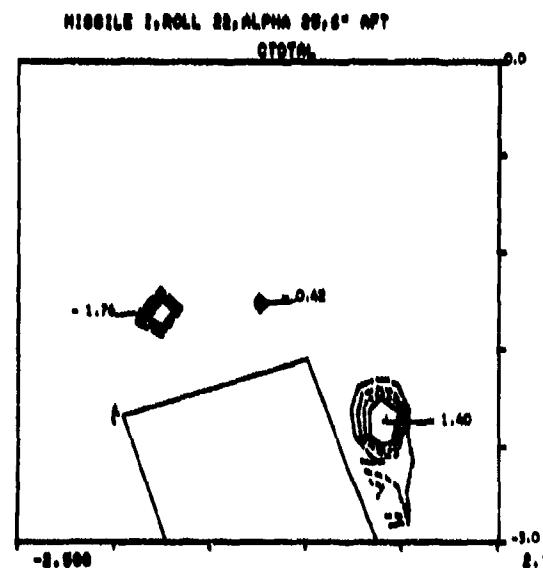
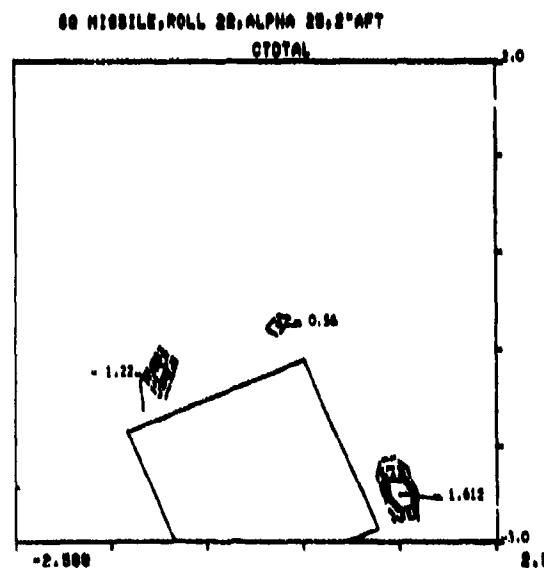
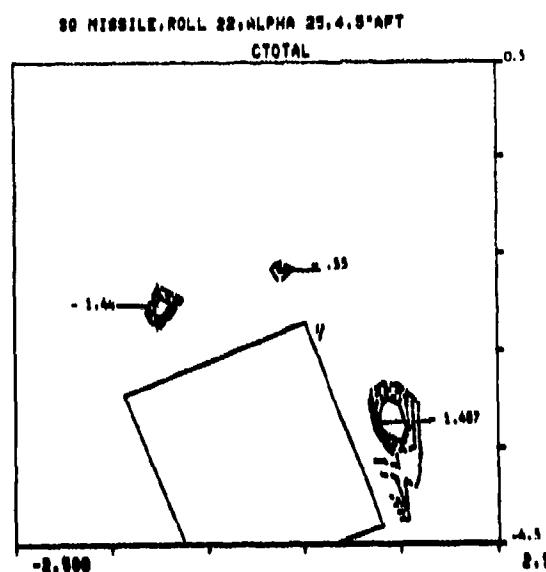
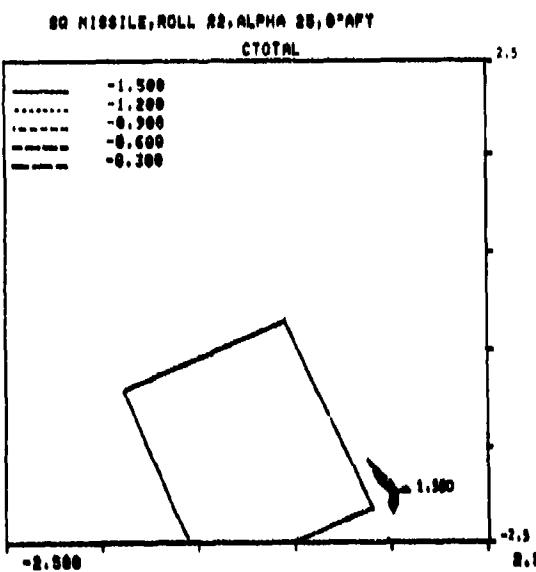
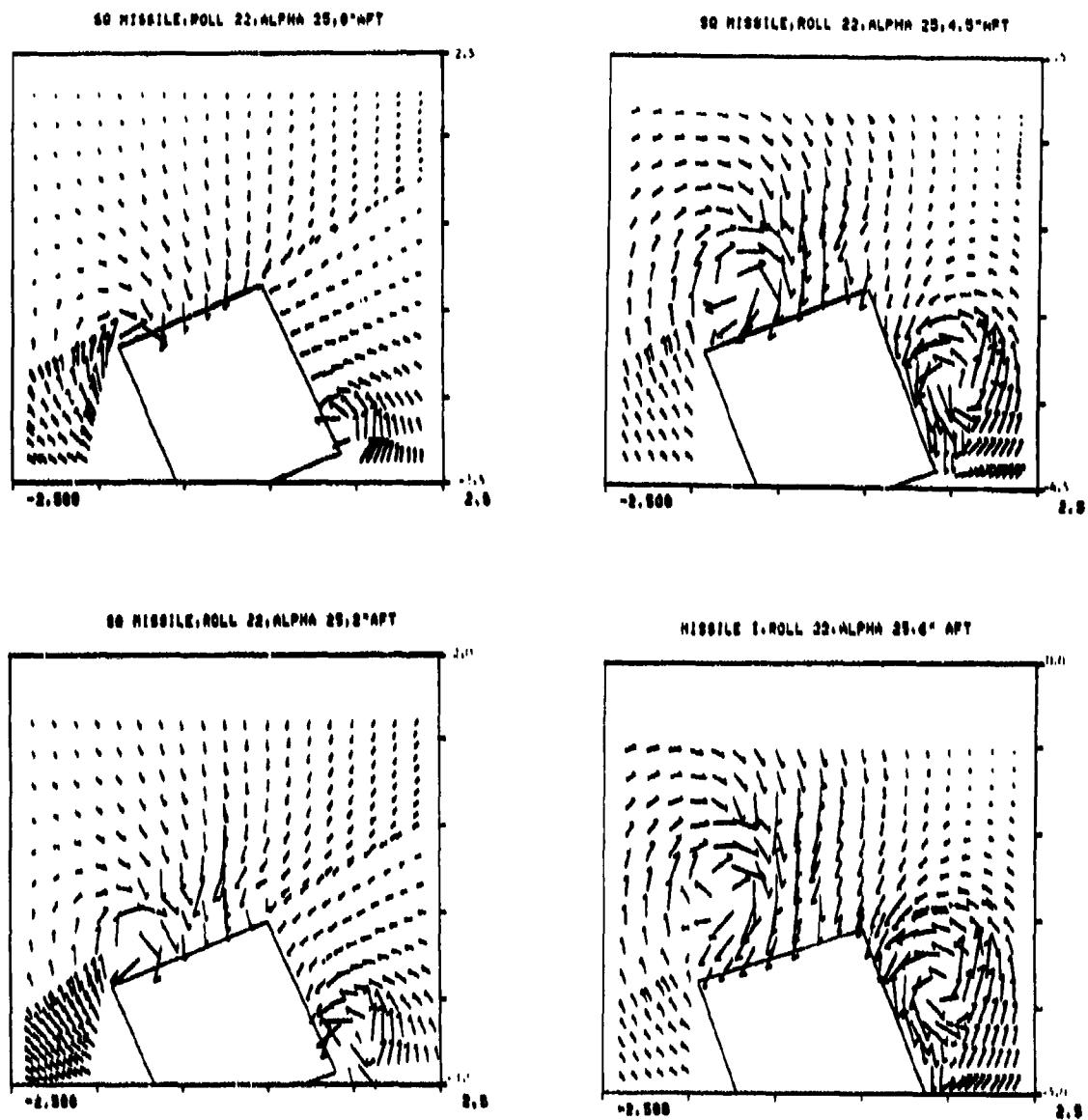


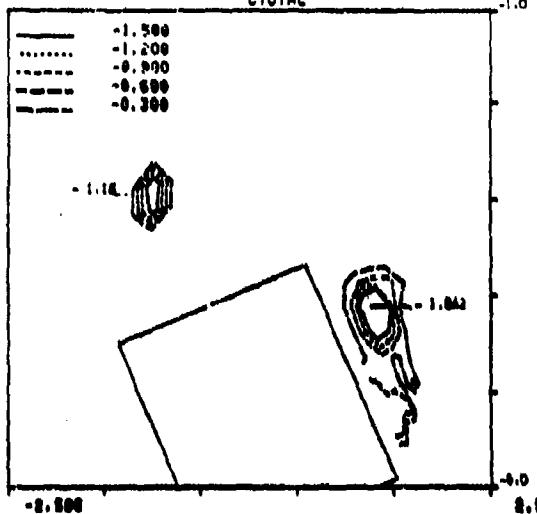
FIGURE C-9A. PRESSURE CONTOUR FLOWFIELD PROFILES, MISSILE I
22 ROLL, 25 AOA. 0-2-4-6 INCHES AFT OF NOSE-BODY
JUNCTION. VIEW LOOKING DOWNSTREAM. INCLUDING SIDES.



**FIGURE C-9B. VELOCITY VECTOR FLOWFIELD PROFILES, MISSILE I
22 ROLL, 25 AOA. 0-2-4-6 INCHES AFT OF NOSE-BODY
JUNCTION. VIEW LOOKING DOWNSTREAM. INCLUDING SIDES.**

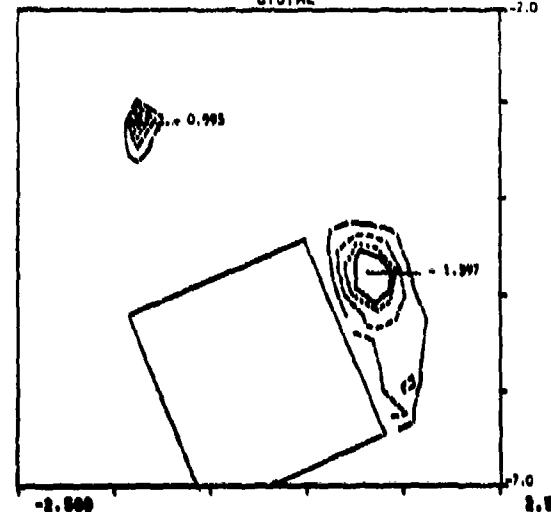
MISSILE I, ROLL 22, ALPHA 25, 0° AFT

CTOTAL



MISSILE I, ROLL 22, ALPHA 25, 10° AFT

CTOTAL



MISSILE I, ROLL 22, ALPHA 25, 18° AFT

CTOTAL

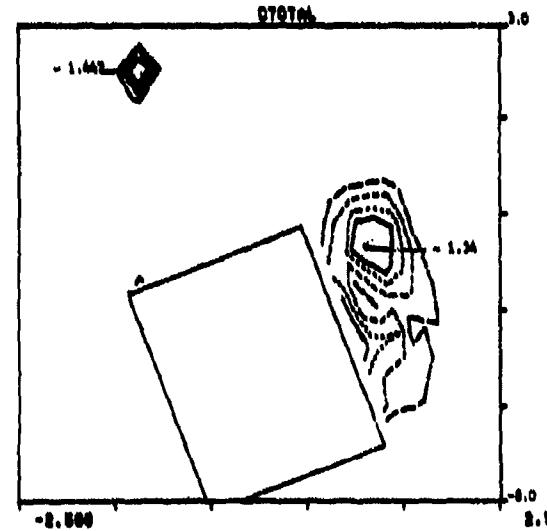
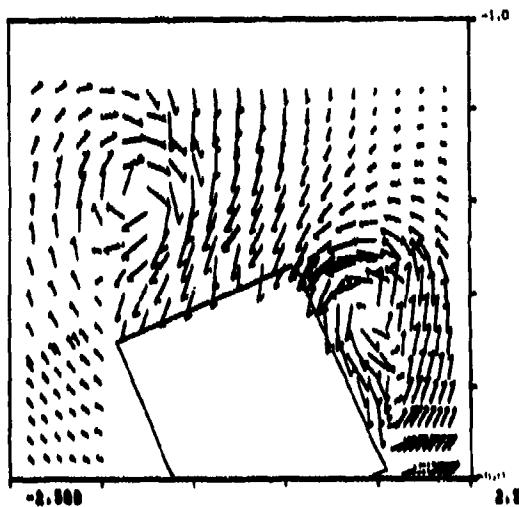
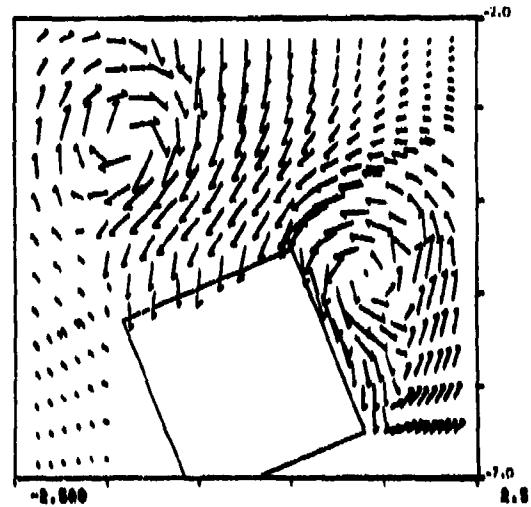


FIGURE C-10A. PRESSURE CONTOUR FLOWFIELD PROFILES, MISSILE I
22 ROLL, 25 AOA. 8-10-12 INCHES AFT OF NOSE-BODY
JUNCTION. VIEW LOOKING DOWNSTREAM. INCLUDING SIDES.

MISSILE I,ROLL 22, ALPHA 25, 8° AFT



MISSILE I,ROLL 22, ALPHA 25, 10° AFT



MISSILE I,ROLL 22, ALPHA 25, 12° AFT

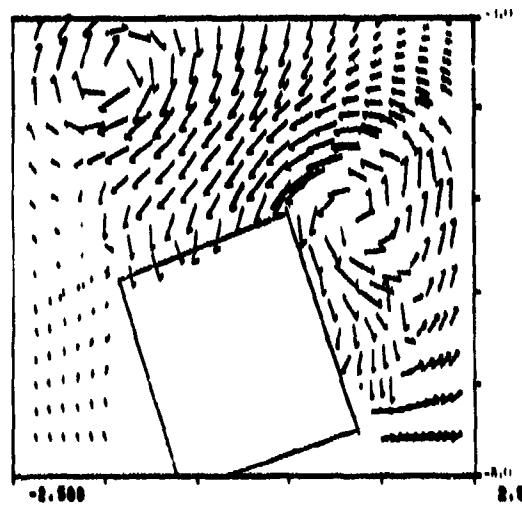
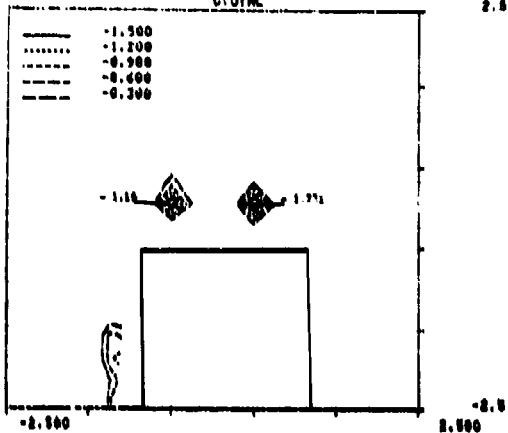
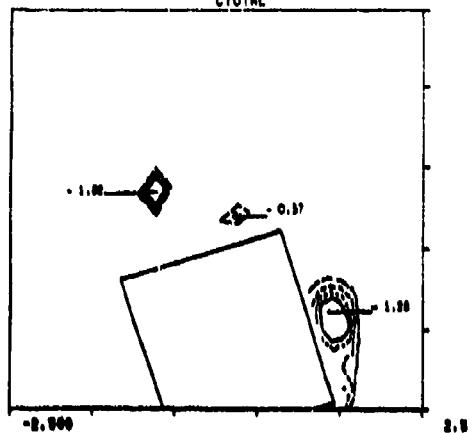


FIGURE C-10B. VELOCITY VECTOR FLOWFIELD PROFILES, MISSILE I
22 ROLL, 25 AOA. 8-10-12 INCHES AFT OF NOSE-BODY
JUNCTION. VIEW LOOKING DOWNSTREAM. INCLUDING SIDES.

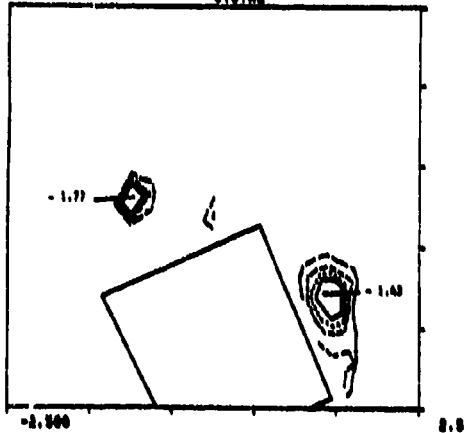
MISSILE I, ROLL 0; BLNT NOS; ALPHA 25
CTOTAL



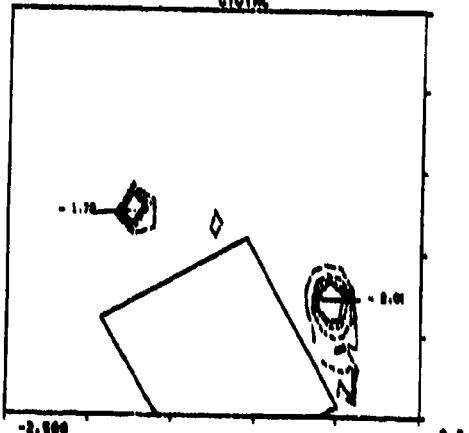
MISSILE I, ROLL 11; BLNT NOS; ALPHA 25
CTOTAL



MISSILE I, ROLL 22.5; BLNT NOS; ALPHA 25
CTOTAL



MISSILE I, ROLL 33; BLNT NOS; ALPHA 25
CTOTAL



MISSILE I ROLL 45; BLNT NOS; ALPHA 25
CTOTAL

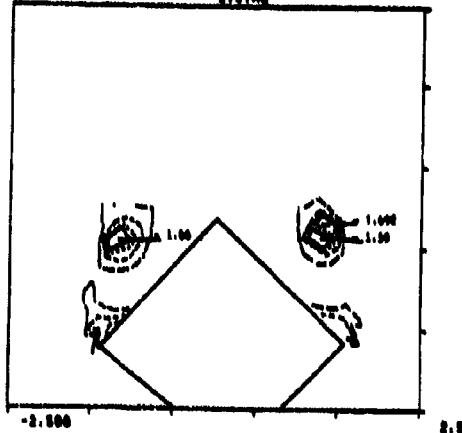
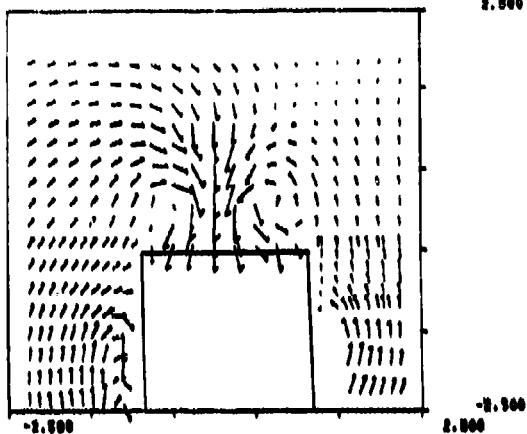
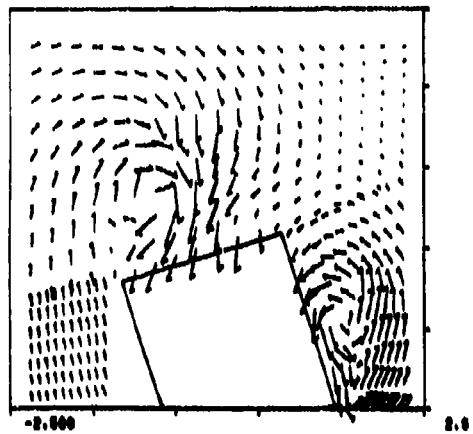


FIGURE C-11A. PRESSURE CONTOUR FLOWFIELD PROFILES, MISSILE I
0-11-22-33-45 ROLL, 2/3 AFT PLANE, VIEW LOOKING
DOWNSTREAM, INCLUDING SIDES. 25 ANGLE OF ATTACK.

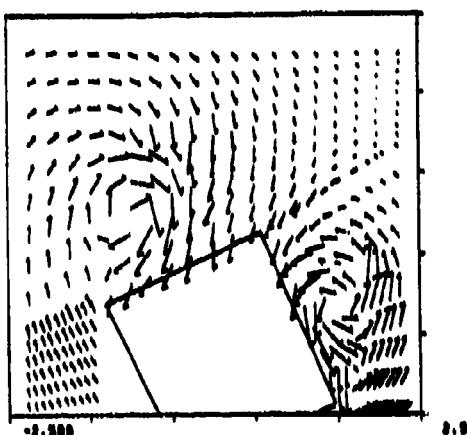
MISSILE I, ROLL 0, BLNT HOG, ALPHA 25



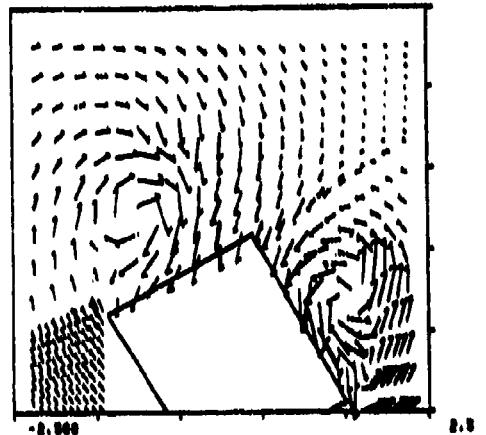
MISSILE I, ROLL 11, BLNT HOG, ALPHA 25



MISSILE I, ROLL 22.5, BLNT HOG, ALPHA 25



MISSILE I, ROLL 33, BLNT HOG, ALPHA 25



MISSILE I, ROLL 45, BLNT HOG, ALPHA 25

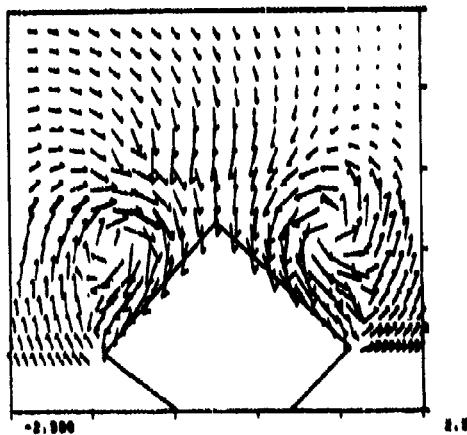


FIGURE C-11B. VELOCITY VECTOR FLOWFIELD PROFILES, MISSILE I
0-11-22-33-45 ROLL, 2/3 AFT PLANE, VIEW LOOKING
DOWNSTREAM, INCLUDING SIDES. 25 ANGLE OF ATTACK.

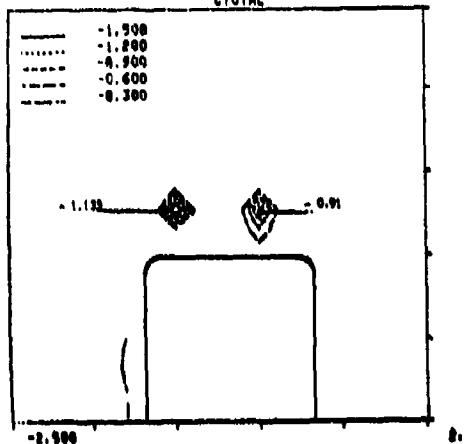
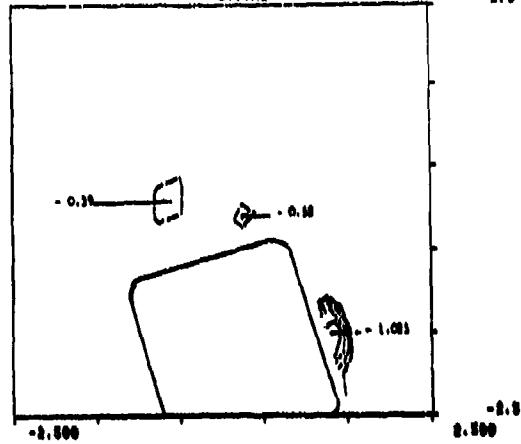
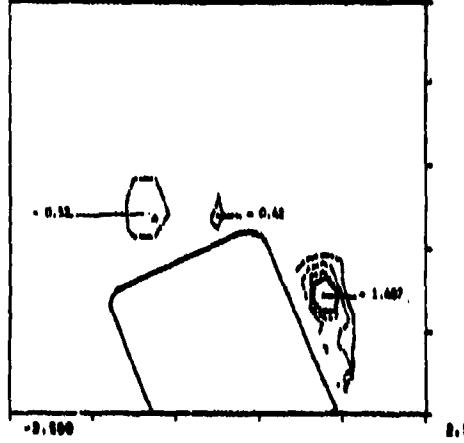
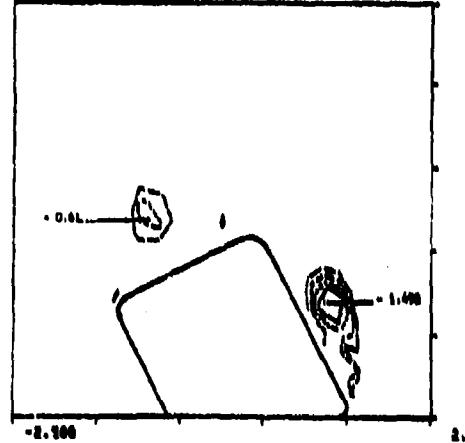
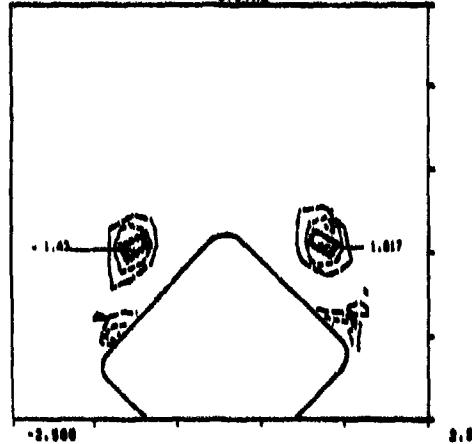
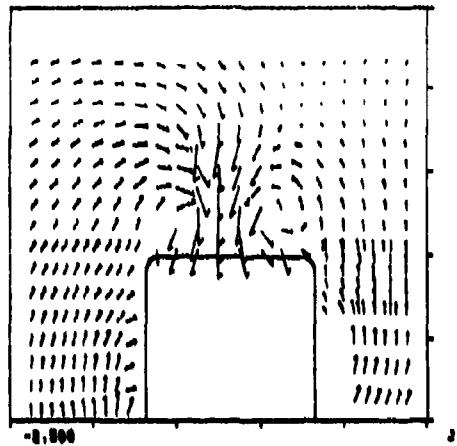
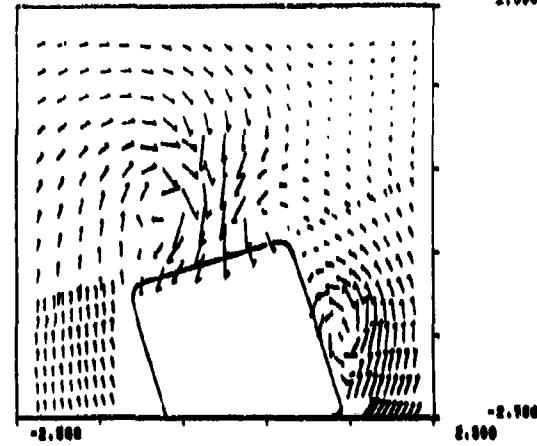
MISSILE II, ROLL 0, BLNT NOS, ALPHA 25
CTOTALMISSILE II, ROLL 11, BLNT NOS, ALPHA 25
CTOTALMISSILE II, ROLL 22.5, BLNT NOS, ALPHA
CTOTALMISSILE II, ROLL 33, BLNT NOS, ALPHA 25
CTOTALMISSILE II, ROLL 45, BLNT NOS, ALPHA 25
CTOTAL

FIGURE C-12A. PRESSURE CONTOUR FLOWFIELD PROFILES, MISSILE II
0-11-22-33-45 ROLL, 2/3 AFT PLANE, VIEW LOOKING
DOWNSTREAM, INCLUDING SIDES. 25 ANGLE OF ATTACK.

MISSILE II, ROLL 0, BLNT HOB, ALPHA 25

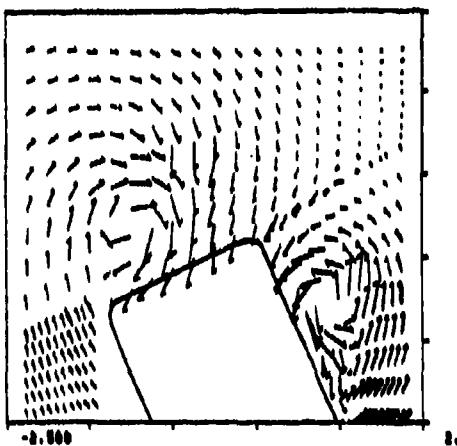


MISSILE II, ROLL 11, BLNT HOB, ALPHA 25 09140 526-JUL-82

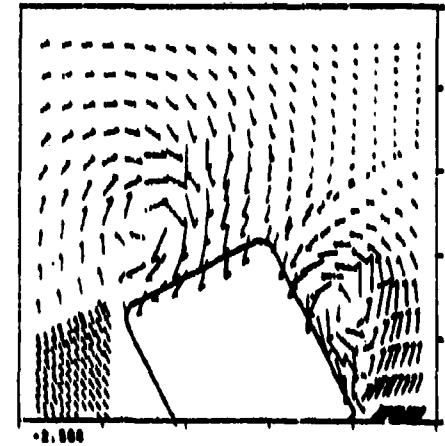


2,500

MISSILE II, ROLL 28.5, BLNT HOB, ALPHA



MISSILE II, ROLL 28, BLNT HOB, ALPHA 25



-2,500
0,000

MISSILE II, ROLL 48, BLNT HOB, ALPHA 25

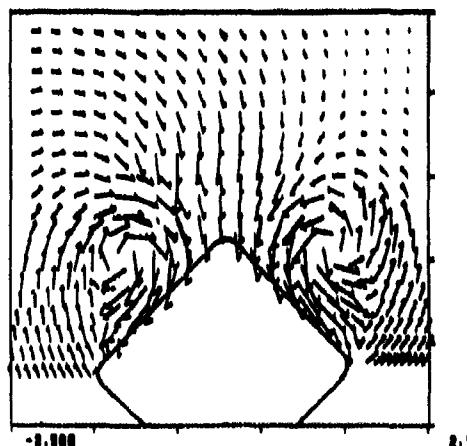
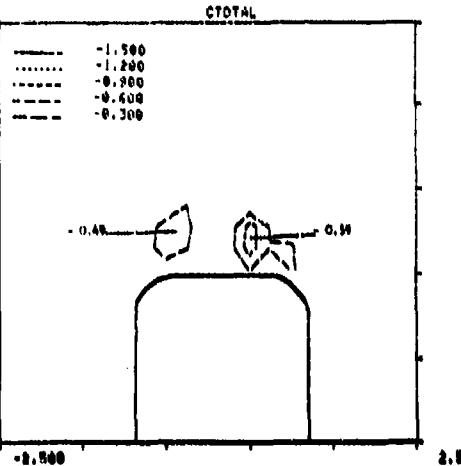
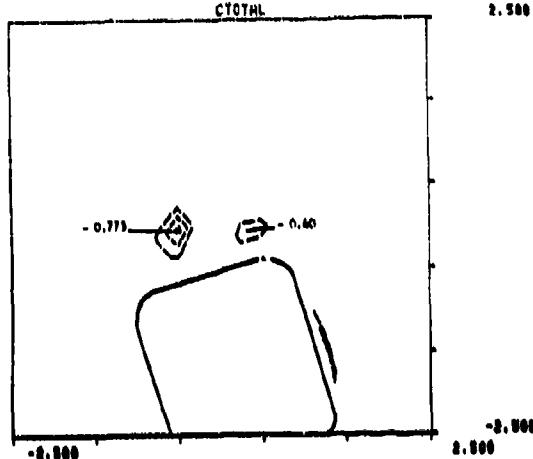


FIGURE C-12B. PRESSURE CONTOUR FLOWFIELD PROFILES, MISSILE II
0-11-22-33-45 ROLL, 2/3 AFT PLANE, VIEW LOOKING
DOWNSTREAM, INCLUDING SIDES. 25 ANGLE OF ATTACK.

MISSILE III, ROLL 0, BLNT NOS, ALPHA 25

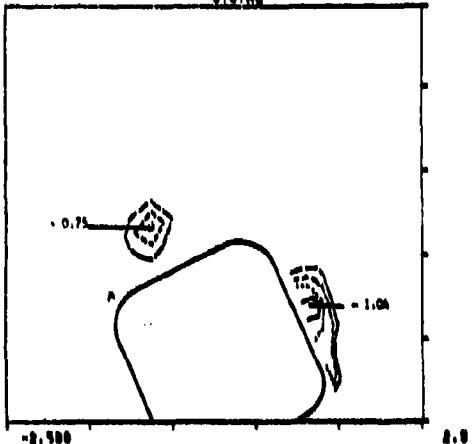


MISSILE III, ROLL 11, BLNT NOS, ALPHA 25

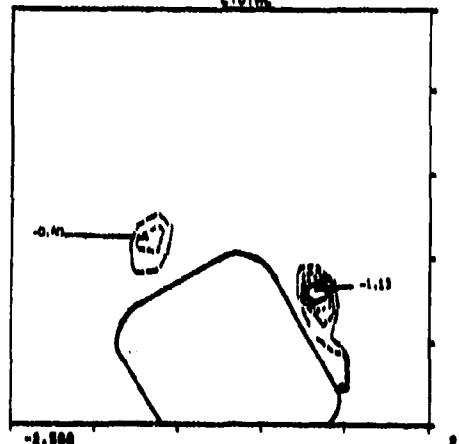


2.500

MISSILE III, ROLL 22.5, BLNT NOS, ALPHA



MISSILE III, ROLL 33.5, BLNT NOS, ALPHA

-0.500 0.500
2.0

MISSILE III, ROLL 45, BLNT NOS, ALPHA 25

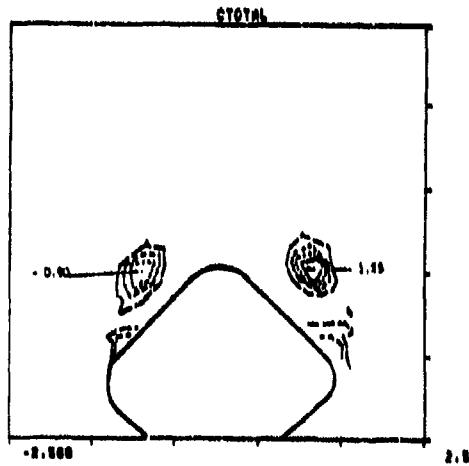
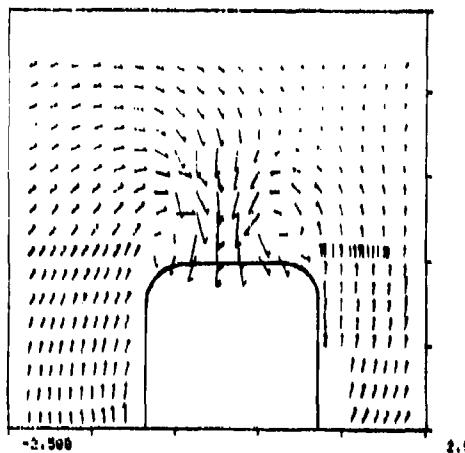
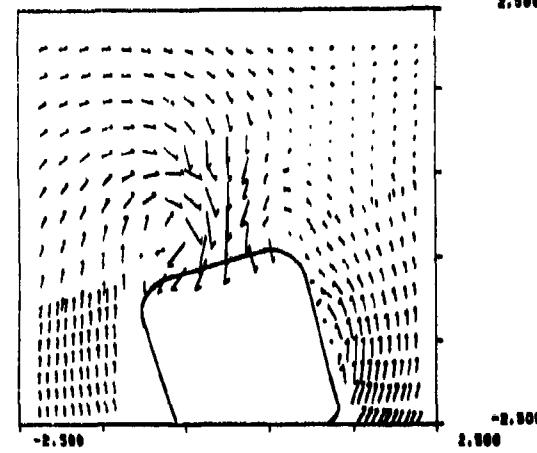
-0.500 0.500
2.0

FIGURE C-13A. PRESSURE CONTOUR FLOWFIELD PROFILES, MISSILE III
0-11-22-33-45 ROLL, 2/3 AFT PLANE, VIEW LOOKING
DOWNSTREAM, INCLUDING SIDES. 25 ANGLE OF ATTACK.

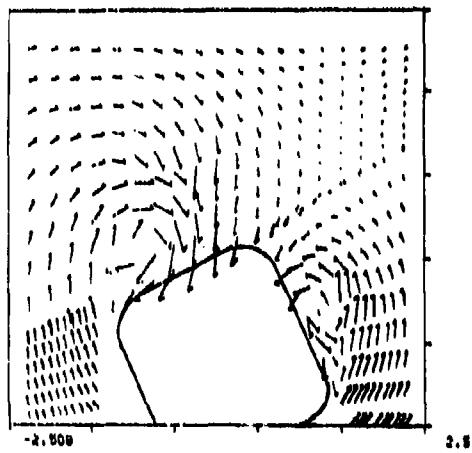
MISSILE III, ROLL 0, BLNT HOS, ALPHA 25



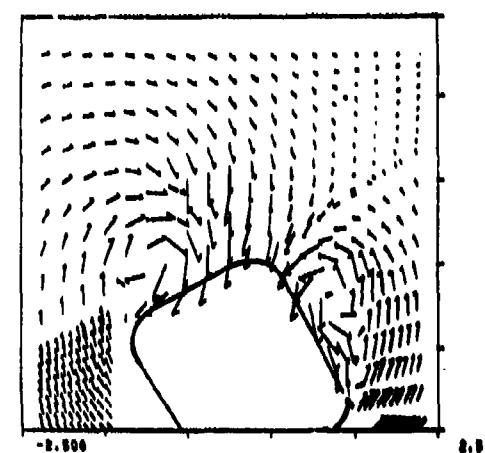
MISSILE III, ROLL 11, BLNT HOS, ALPHA 25



MISSILE III, ROLL 22.5, BLNT HOS, ALPHA



MISSILE III, ROLL 33.5, BLNT HOS, ALPHA



MISSILE III, ROLL 45, BLNT HOS, ALPHA 25

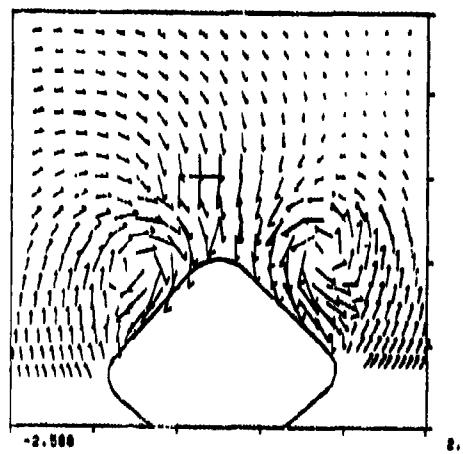


FIGURE C-13B. VELOCITY VECTOR FLOWFIELD PROFILES, MISSILE III
0-11-22-33-45 ROLL, 2/3 AFT PLANE, VIEW LOOKING
DOWNSTREAM, INCLUDING SIDES. 25 ANGLE OF ATTACK.

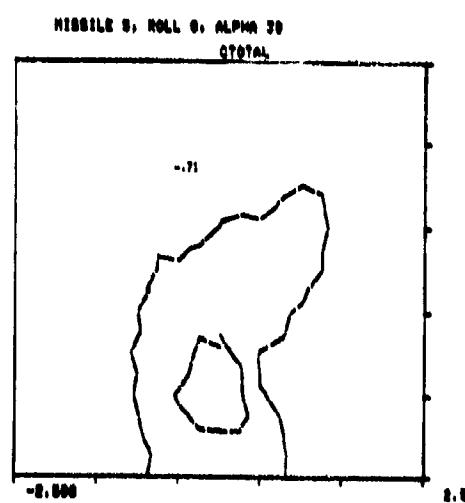
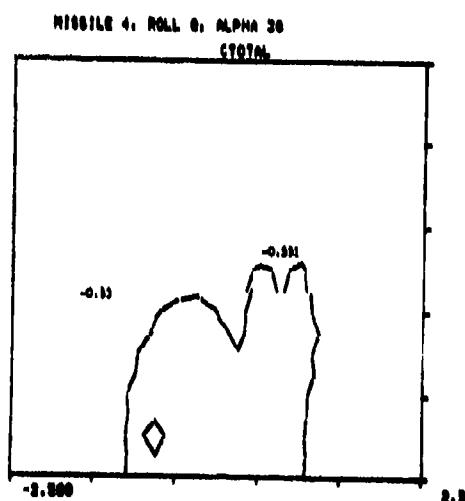
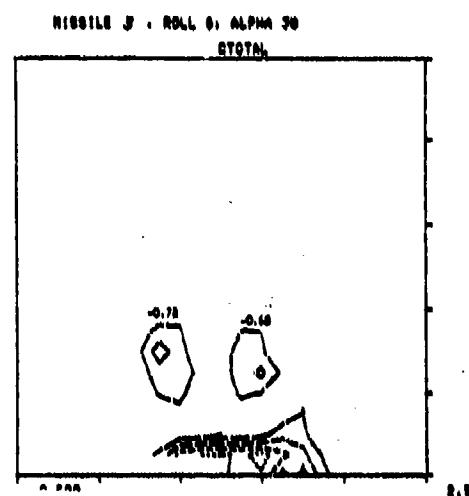
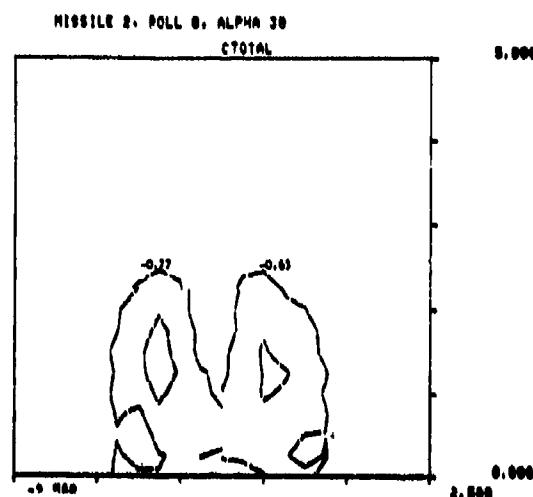
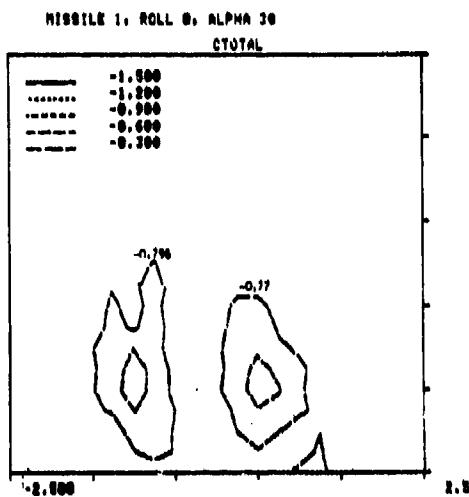
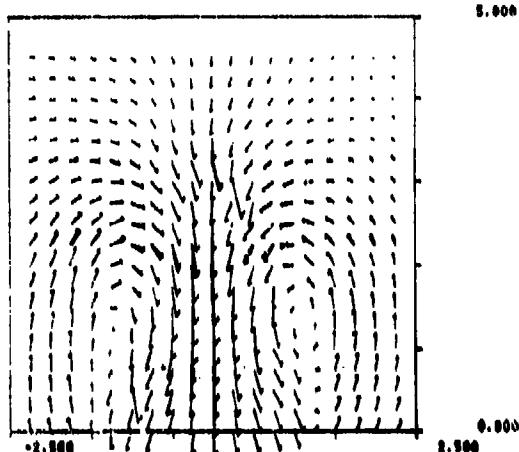
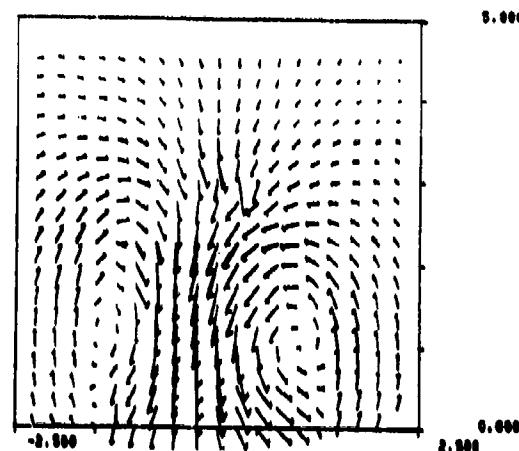


FIGURE C-14A. PRESSURE CONTOUR FLOWFIELD PROFILES, MISSILE 1-5
0 ROLL, 30 AOA, AFT PLANE, VIEW LOOKING UPSTREAM.

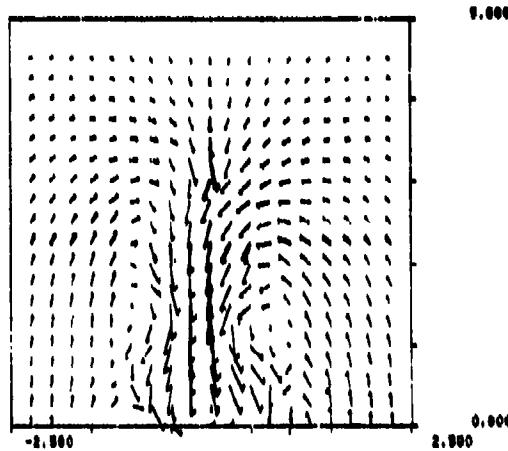
MISSILE 2; ROLL 0; ALPHM 30



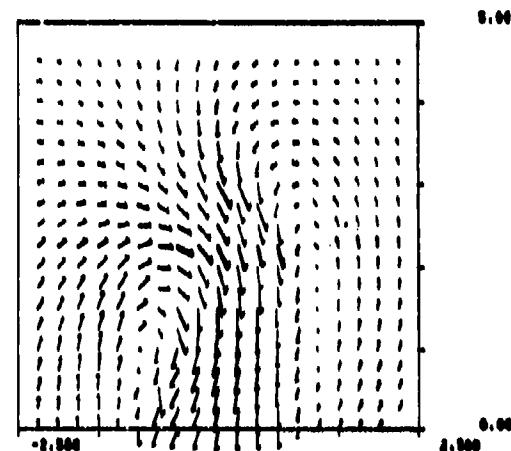
MISSILE 1; ROLL 0; ALPHM 30



MISSILE 3; ROLL 0; ALPHM 30



MISSILE 4; ROLL 0; ALPHM 30



MISSILE 5; ROLL 0; ALPHM 30

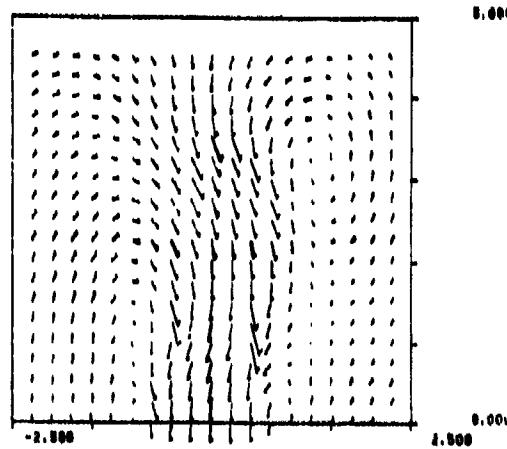


FIGURE C-14B. VELOCITY VECTOR FLOWFIELD PROFILES, MISSILES 1-5
0 ROLL, 30 AOA, AFT PLANE, VIEW LOOKING UPSTREAM.

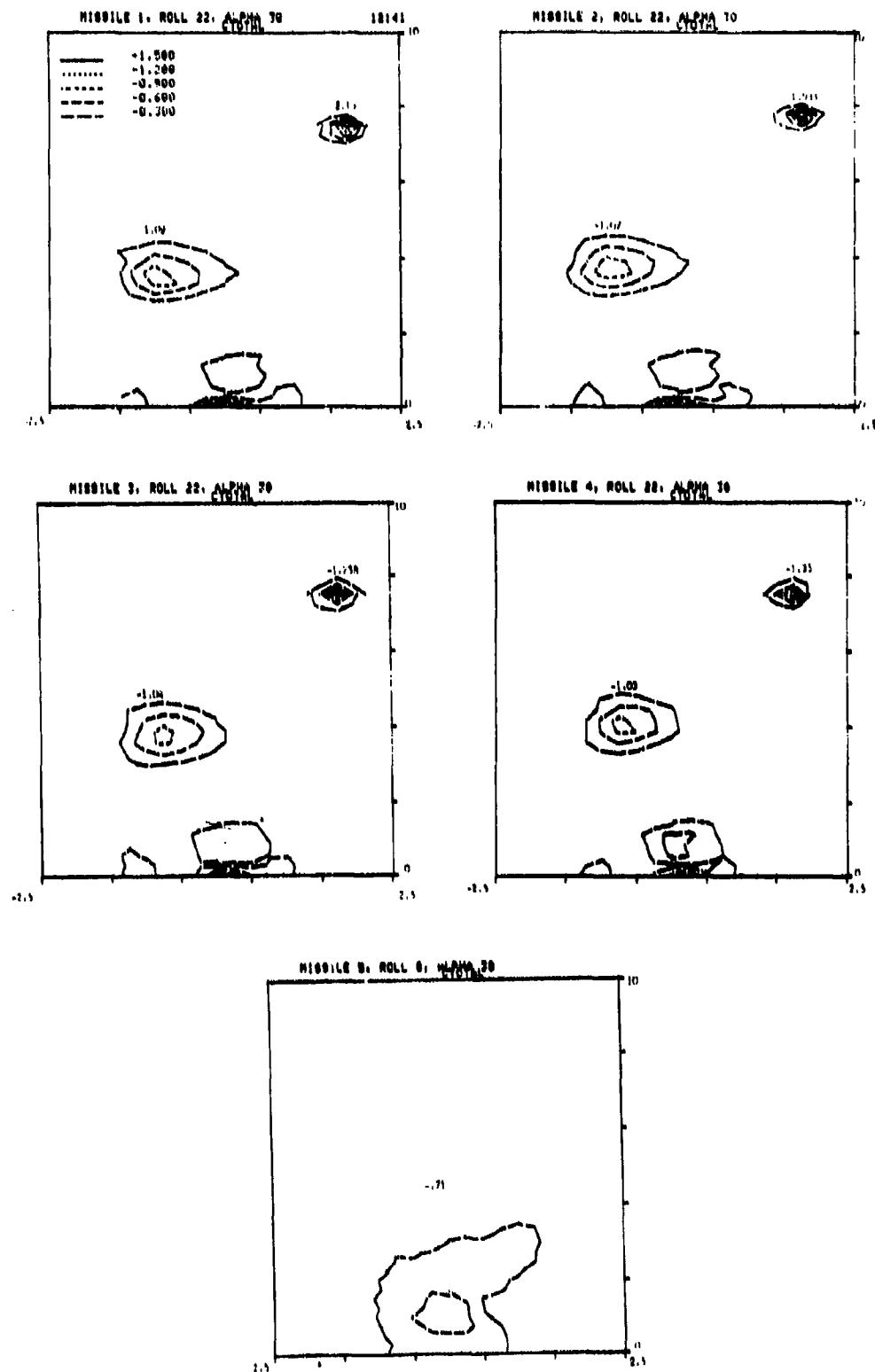


FIGURE C-15A. PRESSURE CONTOUR FLOWFIELD PROFILES, MISSILES 1-5
22 ROLL, 30 AOA, AFT PLANE, VIEW LOOKING UPSTREAM.

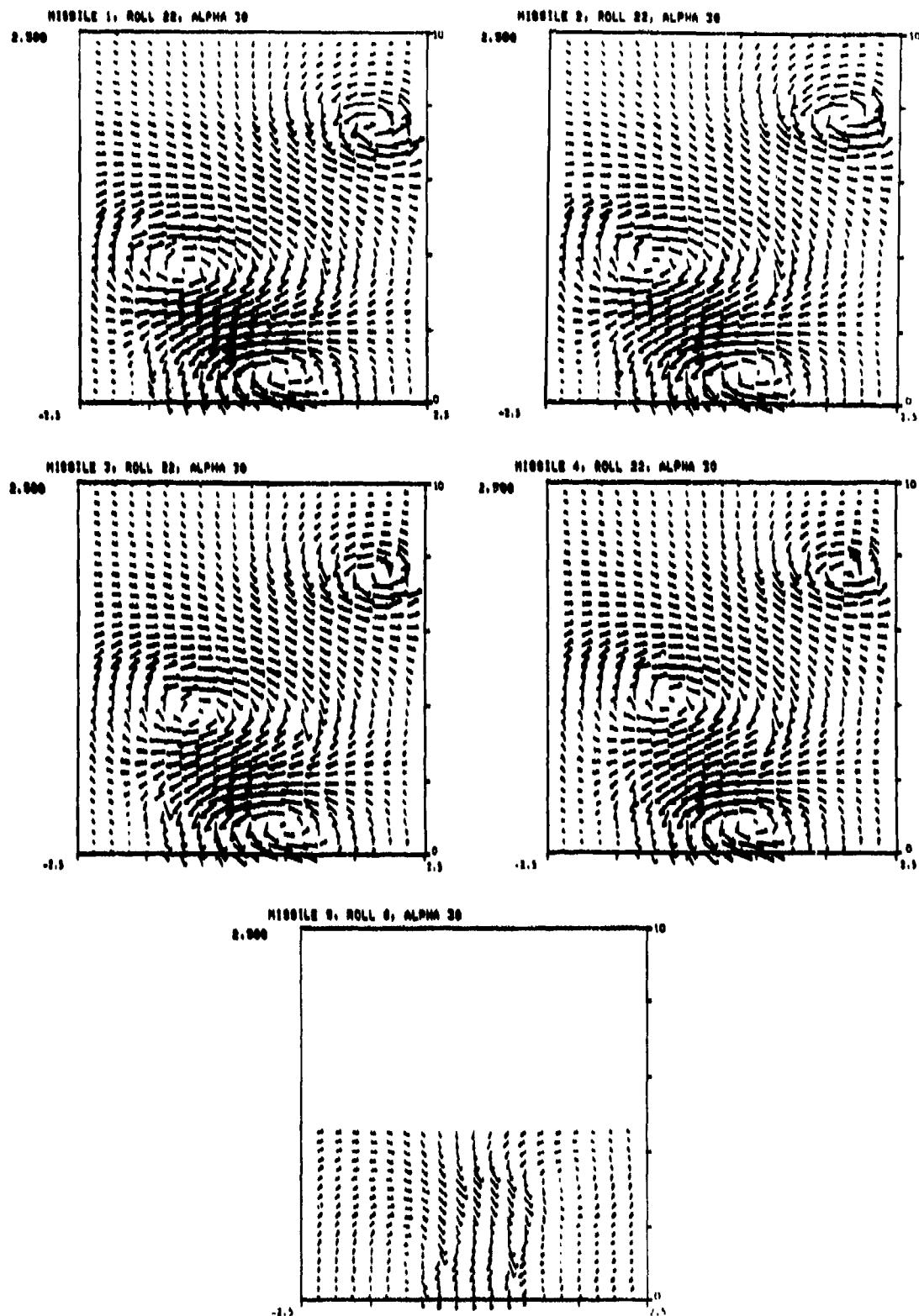


FIGURE C-15B. VELOCITY VECTOR FLOWFIELD PROFILES, MISSILES 1-5
 22 ROLL, 30 AOA, AFT PLANE, VIEW LOOKING UPSTREAM.

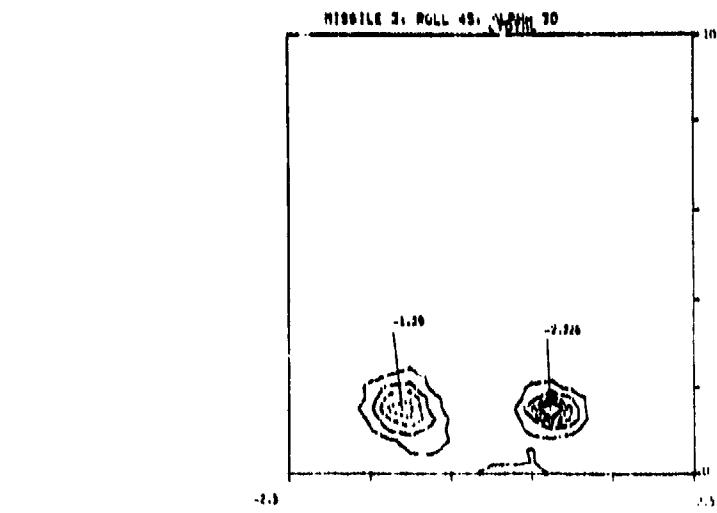
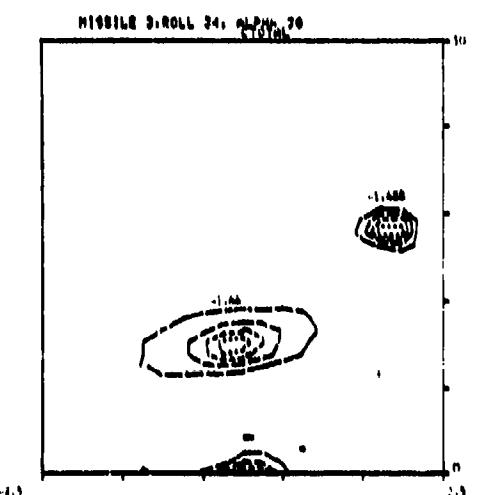
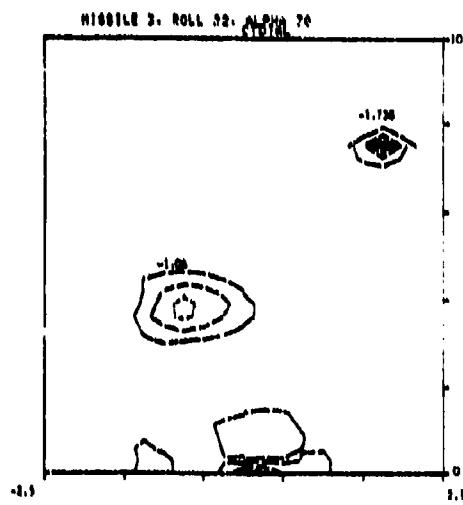
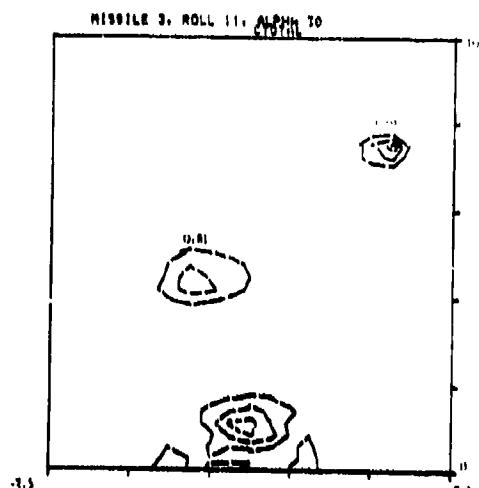
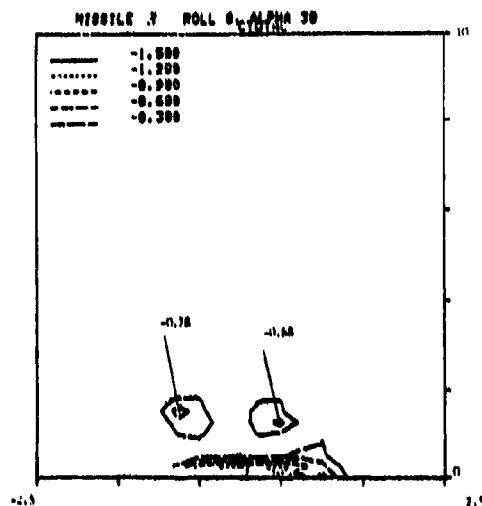
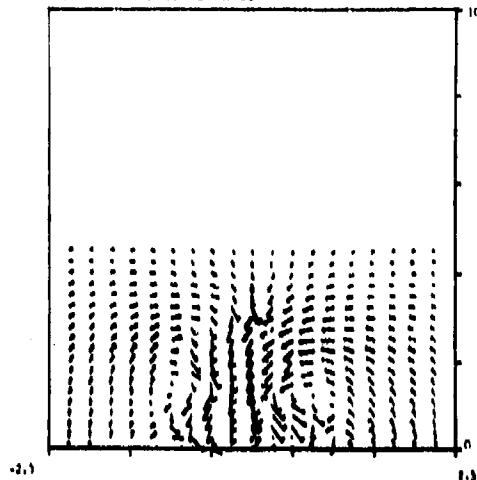
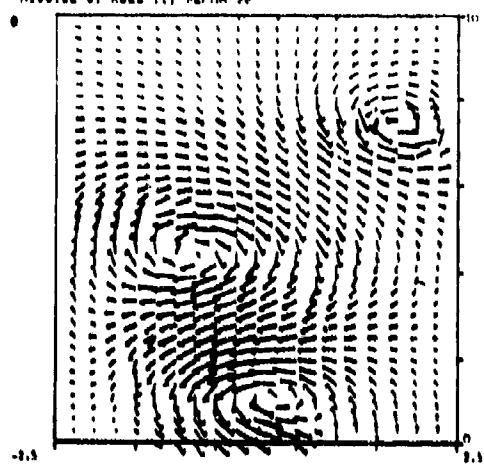


FIGURE C-16A. PRESSURE CONTOUR FLOWFIELD PROFILES, MISSILE 3
0-11-22-33-45 ROLL, 30 AOA, AFT PLANE, VIEW LOOKING UPSTREAM.

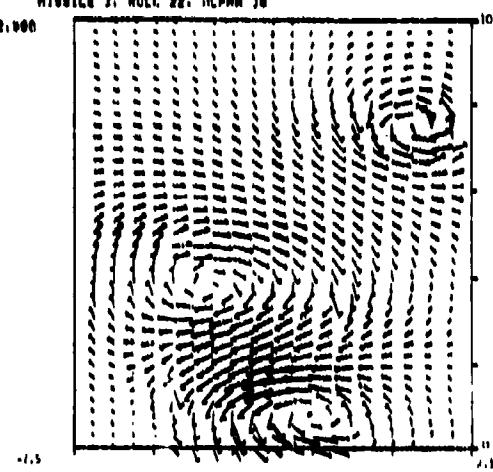
MISSILE 3, ROLL 81, ALPHA 30



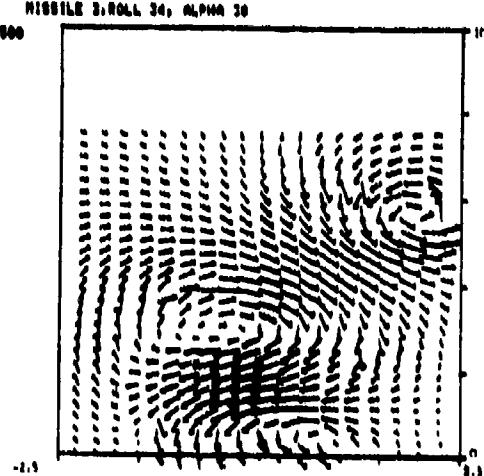
MISSILE 3, ROLL 11, ALPHA 70



MISSILE 3, ROLL 22, ALPHA 70



MISSILE 3, ROLL 34, ALPHA 30



MISSILE 3, ROLL 48, ALPHA 70

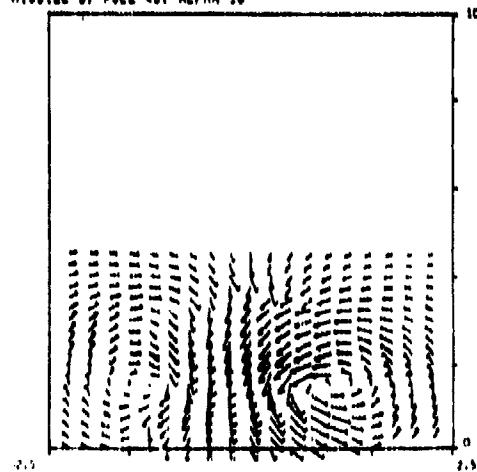


FIGURE C-16B. VELOCITY VECTOR FLOWFIELD PROFILES, MISSILE 3
0-11-22-33-45 ROLL, 30 AOA, AFT PLANE, VIEW LOOKING UPSTREAM.

APPENDIX D

Tuft Grid Photographs of the Flowfield

Qualitative flowfield data were obtained for various missile configurations and orientations using a tuft grid. These tests were conducted by placing a grid of wool tufts in the flowfield on the leeward side of the missile, and then photographing the tuft patterns. The tests were conducted in the subsonic wind tunnel at a freestream velocity of 100 fps. All tests were conducted on missiles without fins.

Figure D.01 shows a schematic representation of the tuft grid test setup. The tuft grid was placed at 3 locations (forward, mid, and aft) along the leeward side of the missile body, perpendicular to the freestream velocity as shown in the figure. The forward plane was located at the nose-body junction of the missile, the mid plane 6 inches aft of the nose-body junction, and the aft plane at the aft end of the missile. A camera was mounted downstream of the model, and photographs were taken of the tufts in each of the 3 locations.

For missiles of fineness ratio 8, photographs were taken of tuft patterns in all 3 flowfield planes. The four different cross-section bodies with the blunt nose were tested at 10, 15, 20, and

25 degrees pitch and 0, 11, 22, 33, and 45 degrees roll. In addition, the 20 π corner radius body with the pointed nose was tested at 10 and 25 degree pitch and 0, 22, and 45 degrees roll. Table D-1 shows the various missile configurations and orientations tested for missiles of fineness ratio 8. Figures D-1 through D-23 show the photographs of the tuft patterns for the various missile configurations and orientations tested. Since the camera was mounted downstream of the tufts, all photograph views are looking upstream or at the aft end of the missile.

For missiles of fineness ratio 16, photographs were taken of tuft patterns only in the aft plane. Five different cross-section bodies with the blunt nose were tested at 30 degree pitch and 0, 11, 22, 33, and 45 degrees roll. The square body was also tested at 10, 15, 20, and 25 degrees pitch and 22 and 45 degrees roll. These various missile configurations and orientations tested are shown in Table D-2, and the tuft photographs are shown in Figures D-23 through D-30. All tuft grid photographic views are looking upstream.

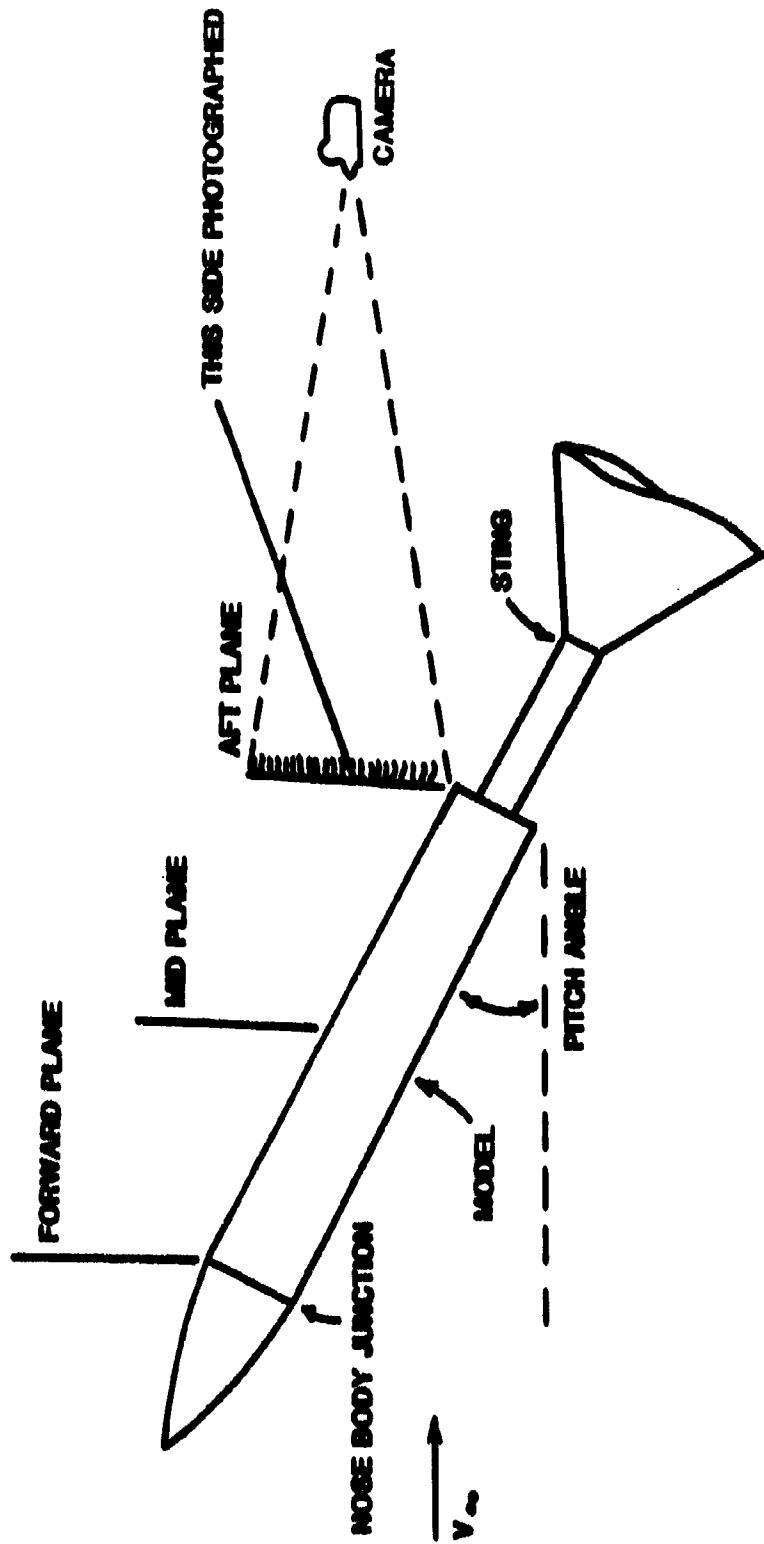


Figure D.01 Side View of Tuft Grid Test Setup

TABLE D-1
TUFT GRID PHOTOS FOR MISSILES OF FINENESS RATIO 8*

MISSILE (1) BODY	NOSE (2) SHAPE	PITCH ANGLE	ROLL ANGLE	GRID LOCATION (PLANE)	FIGURE
I	BL	10°, 25°	0°, 22°, 45°	Front	D-1
I	BL	10°, 25°	0°, 22°, 45°	Mid	D-2
I	BL	20°	0°, 11°, 22°, 33°, 45°	Mid	D-3
I	BL	10°	0°, 22°, 45°	Aft	D-4
I	BL	15°	0°, 11°, 22°, 33°, 45°	Aft	D-5
I	BL	20°	0°, 11°, 33°, 45°	Aft	D-6
I	BL	25°	0°, 11°, 22°, 33°, 45°	Aft	D-7
I	BL	10°, 25°	0°, 22°, 45°	Front	D-8
II	BL	10°, 25°	0°, 22°, 45°	Mid	D-9
II	BL	10°	0°, 22°, 45°	Aft	D-10
II	BL	15°	0°, 11°, 22°, 33°, 45°	Aft	D-11
II	BL	20°	0°, 11°, 22°, 33°, 45°	Aft	D-12
II	BL	25°	0°, 11°, 22°, 33°, 45°	Aft	D-13
II	BL	10°, 25°	0°, 22°, 45°	Front	D-14
III	BL	10°, 25°	0°, 22°, 45°	Mid	D-15

TABLE D-1

TUFT EXIT RATIOS FOR MISSILES OF FINENESS RATIO 8*

MISSILE (1) FORM	NOSE (2) SHAPE	PITCH ANGLE	ROLL ANGLE	GRID (3) LOCATION (PLANE)	FIGURE
III	BL	10°	0°, 22°, 45°	Aft	D-16
III	BL	15°	0°, 11°, 22°, 33°, 45°	Aft	D-17
III	BL	20°	0°, 11°, 22°, 33°, 45°	Aft	D-18
III	BL	25°	0°, 11°, 22°, 33°, 45°	Aft	D-19
III	PT	10°, 25°	0°, 22°, 45°	Front	D-20
III	PT	10°, 25°	0°, 22°, 45°	Mid	D-21
III	PT	10°, 25°	0°, 22°, 45°	Aft	D-22
IV	BL	15°, 20°, 25°	0°	Aft	D-23

*Missiles with the blunt nose actually have a fineness ratio of 7.5 since the blunt nose is only 3 inches long as compared to the 4 inch long pointed nose.

(1) Body configurations:

- I - Square
- II - 10% corner radius
- III - 20% corner radius
- IV - Round

(2) Nose configurations:

- BL - Blunt nose
- PT - Pointed nose

(3) Grid Locations:

See Figure D.01 for
location of forward
and aft planes

TABLE D-2
TUFT GRID PHOTOS FOR MISSILES OF FINENESS RATIO 16*

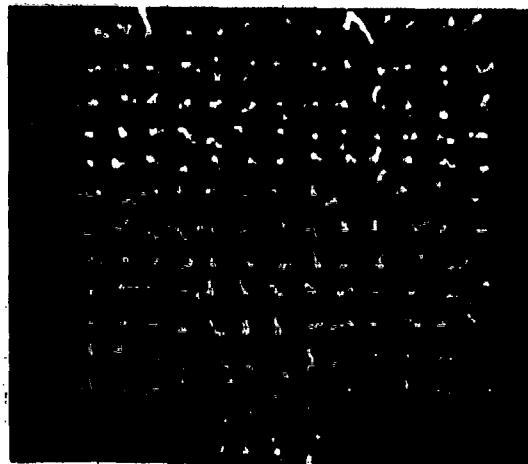
MISSILE (1) BODY	NOSE (2) SHAPE	PITCH ANGLE	ROLL ANGLE	GRID (3) LOCATION (PLANE)		FIGURE
				FIGURE	FIGURE	
1	BL	10°, 15°		22°, 45°		D-24
	BL	20°, 25°		22°, 45°		
1	BL	30°		0°, 11°, 22°, 33°, 45°		D-25
	BL	30°		0°, 11°, 22°, 33°, 45°		
2	BL	30°		0°, 11°, 22°, 33°, 45°		D-26
	BL	30°		0°, 11°, 22°, 33°, 45°		
3	BL	30°		0°, 11°, 22°, 33°, 45°		D-27
	BL	30°		0°, 11°, 22°, 33°, 45°		
4	BL	30°		0°, 11°, 22°, 33°, 45°		D-28
	BL	30°		0°, 11°, 22°, 33°, 45°		
5	BL	30°	0°			D-29
	BL	30°	0°			
						D-30

Missiles with the blunt nose actually have a fineness ratio of 15.33 since the blunt nose is only 3 inches long as compared to the 4 inch long pointed nose.

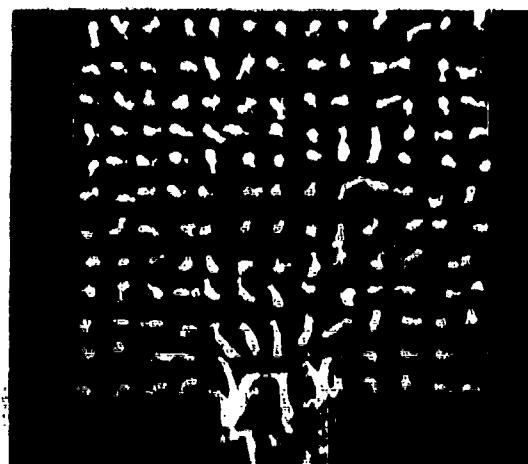
(1) Body Configurations: (2) Nose Configurations (3) Grid Location:

- 1 - Square
- 2 - 10Z corner radius
- 3 - 20Z corner radius
- 4 - 30Z corner radius
- 5 - Round

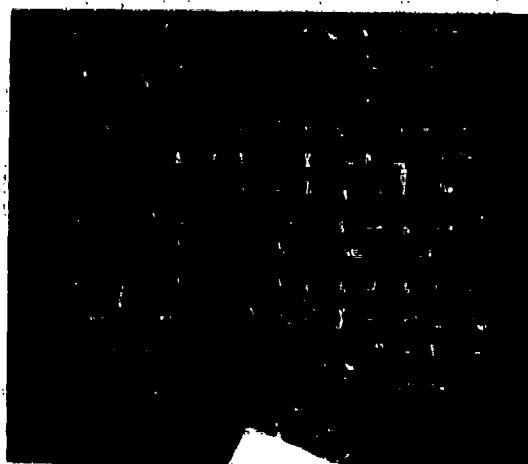
See Figure D-01 for location of aft plane



1a. MISSILE 1, 0° ROLL, 10° PITCH



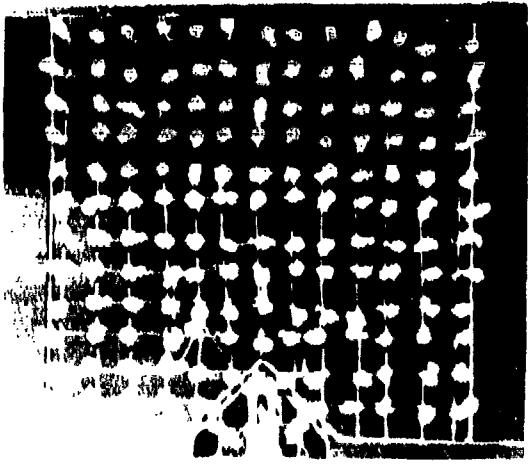
1d. MISSILE 1, 0° ROLL, 25° PITCH



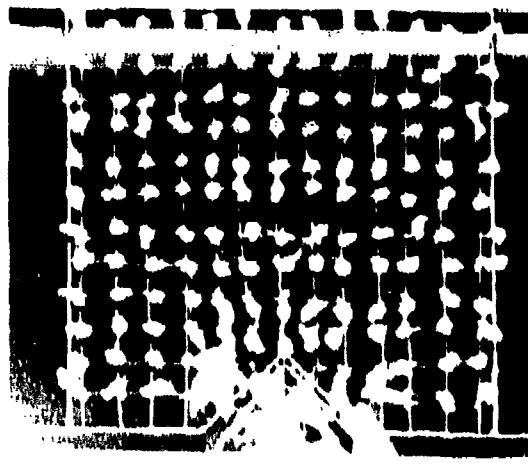
1b. MISSILE 1, 22° ROLL, 10° PITCH



1e. MISSILE 1, 22° ROLL, 25° PITCH

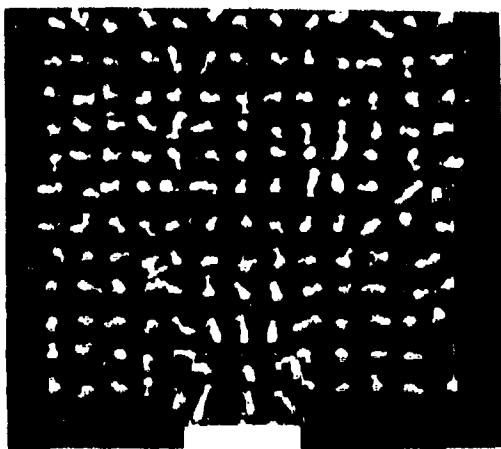


1c. MISSILE 1, 45° ROLL, 10° PITCH

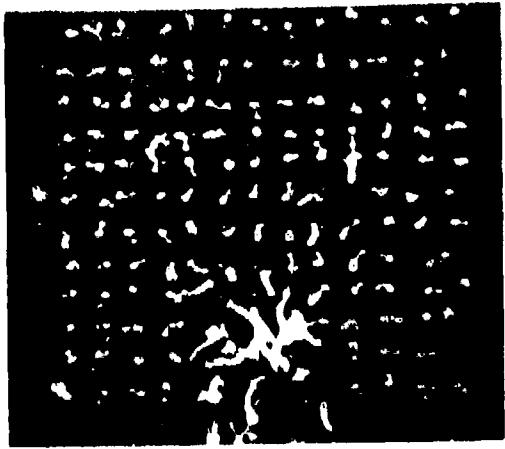


1f. MISSILE 1, 45° ROLL, 25° PITCH

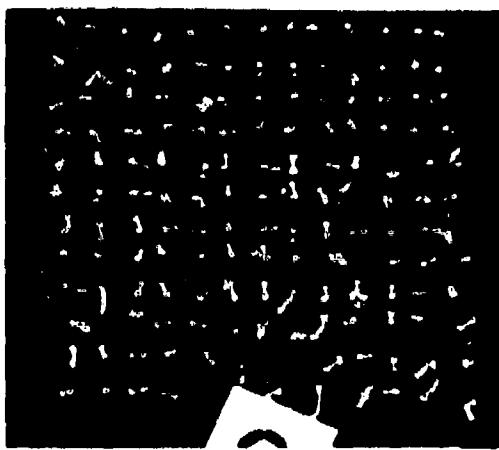
FIGURE D-1. TUFT GRID PHOTOS IN FORWARD PLANE
FOR MISSILE OF FINENESS RATIO 7.5.



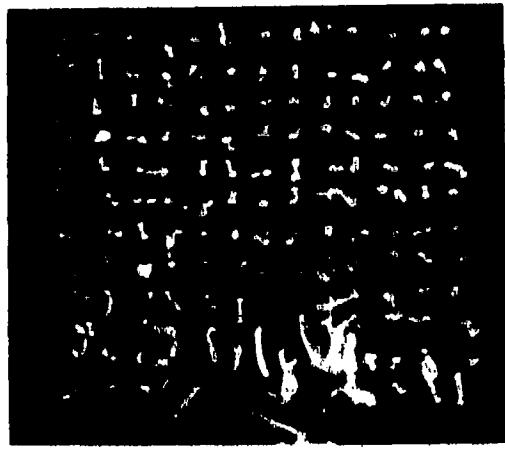
2a. MISSILE 1, 0° ROLL, 10° PITCH



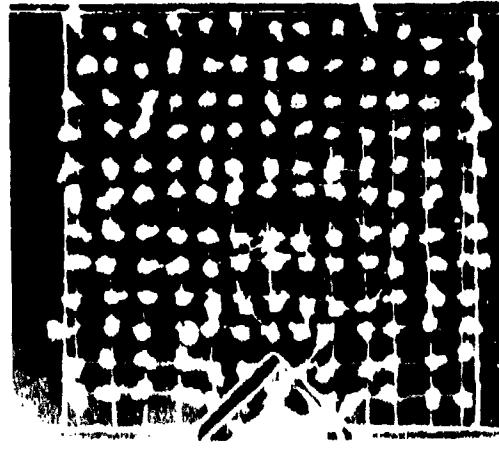
2d. MISSILE 1, 0° ROLL, 25° PITCH



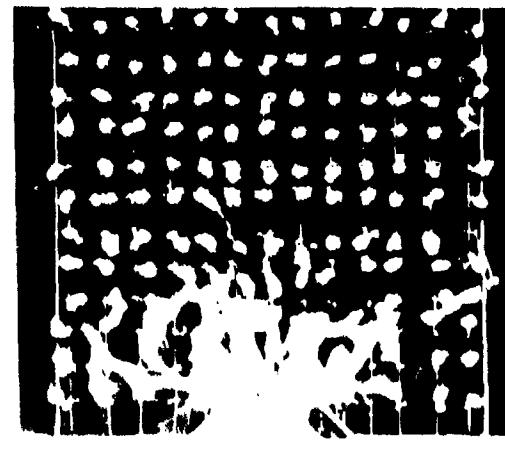
2b. MISSILE 1, 22° ROLL, 10° PITCH



2c. MISSILE 1, 22° ROLL, 25° PITCH

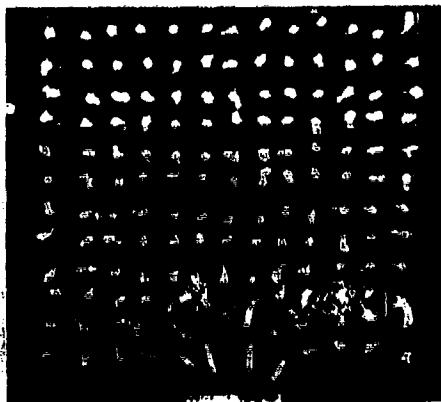


2e. MISSILE 1, 45° ROLL, 10° PITCH

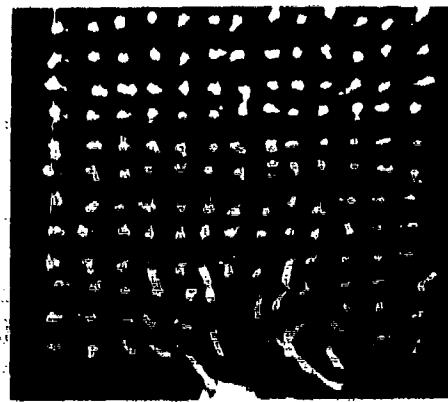


2f. MISSILE 1, 45° ROLL, 25° PITCH

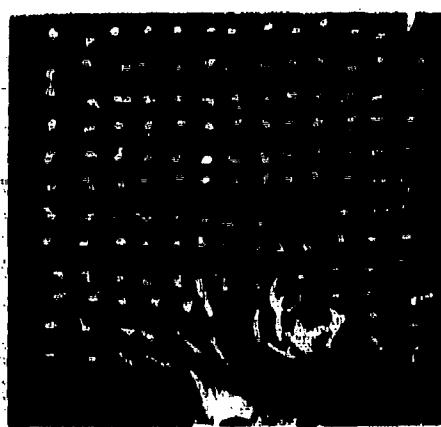
FIGURE D-2. TUFT GRID PHOTOS IN MID PLANE
FOR MISSILE OF FINENESS RATIO 7.5



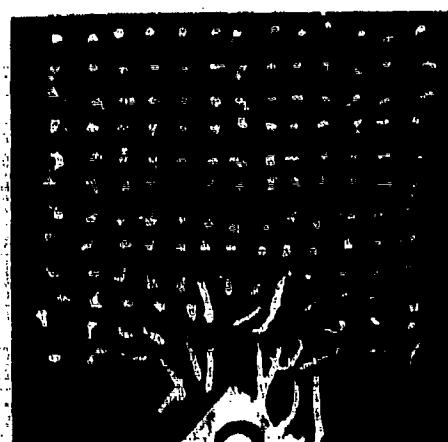
3a. MISSILE I, 0° ROLL, 20° PITCH



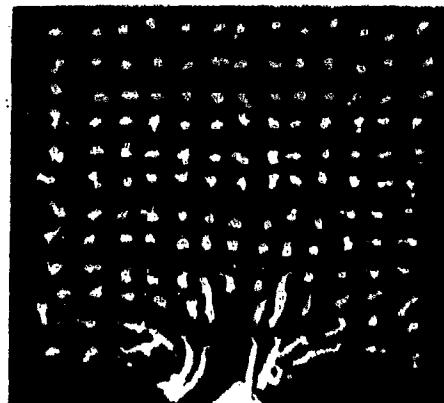
3b. MISSILE I, 11° ROLL, 20° PITCH



3c. MISSILE I, 22° ROLL, 20° PITCH

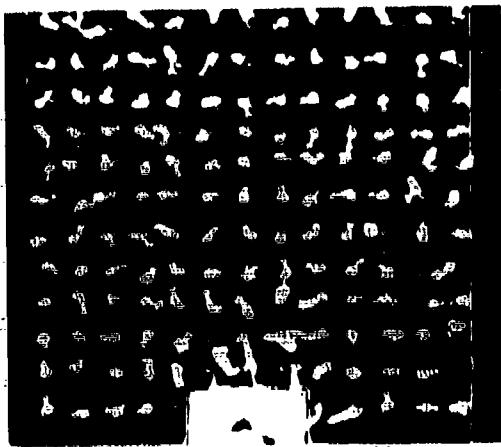


3d. MISSILE I, 33° ROLL, 20° PITCH

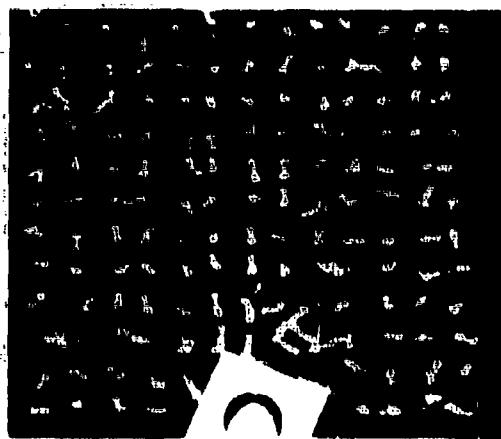


3e. MISSILE I, 45° ROLL, 20° PITCH

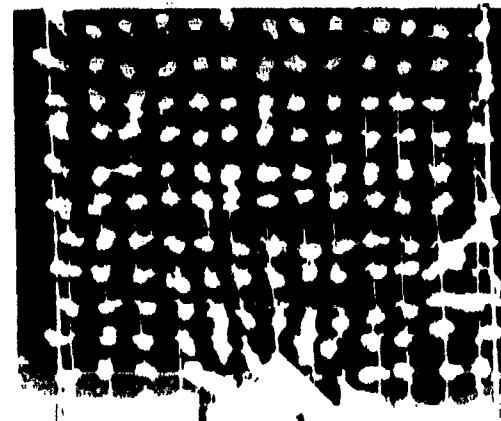
FIGURE D-3. TUFT GRID PHOTOS IN MID PLANE
FOR MISSILE OF FINENESS RATIO 7.5 .



4a. MISSILE I, 0° ROLL, 10° PITCH

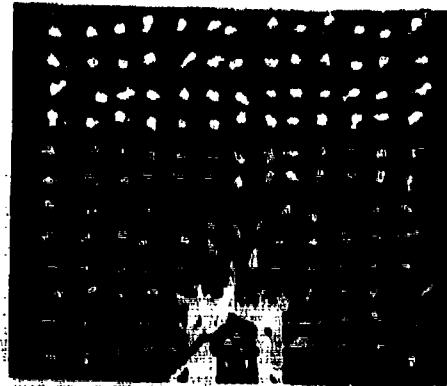


4b. MISSILE I, 22° ROLL, 10° PITCH

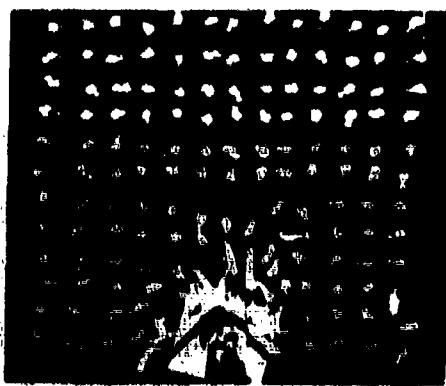


4c. MISSILE I, 45° ROLL, 10° PITCH

FIGURE D-4. TUFT GRID PICTURES IN AFT PLANE
FOR MISSILE OF FINENESS RATIO 7.5 .



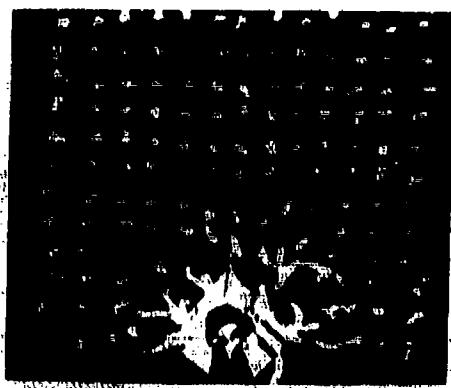
5a. MISSILE I, 0° ROLL, 15° PITCH



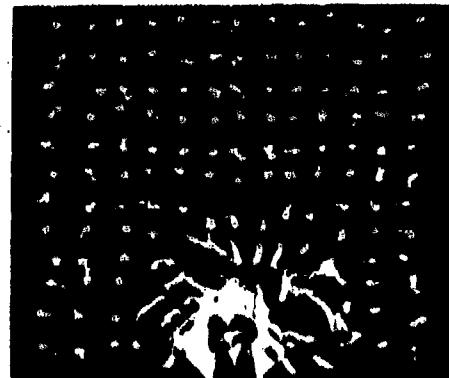
5b. MISSILE I, 11° ROLL, 15° PITCH



5c. MISSILE I, 22° ROLL, 15° PITCH

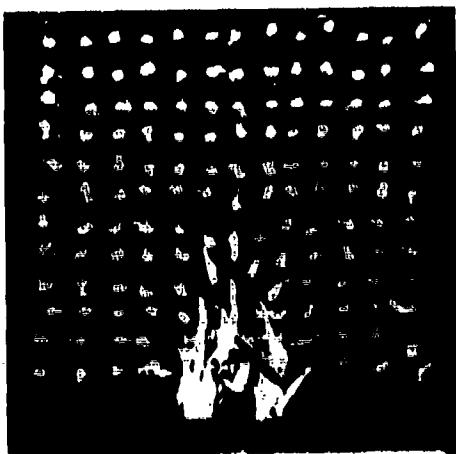


5d. MISSILE I, 33° ROLL, 15° PITCH

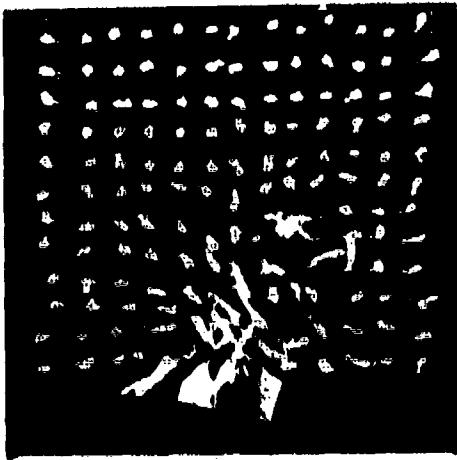


5e. MISSILE I, 45° ROLL, 15° PITCH

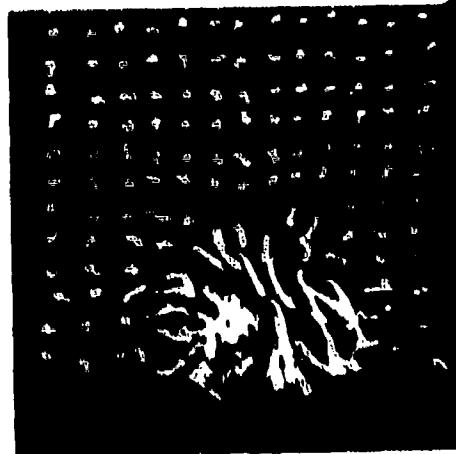
FIGURE D-5. TUFT GRID PHOTOS IN AFT PLANE
FOR MISSILE OF FINENESS RATIO 7.5.



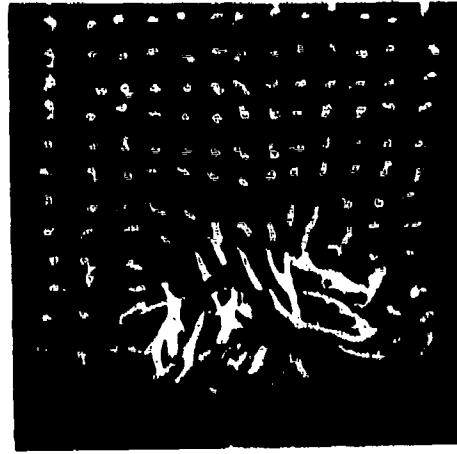
6a. MISSILE I, 0° ROLL, 20° PITCH



6b. MISSILE I, 11° ROLL, 20° PITCH

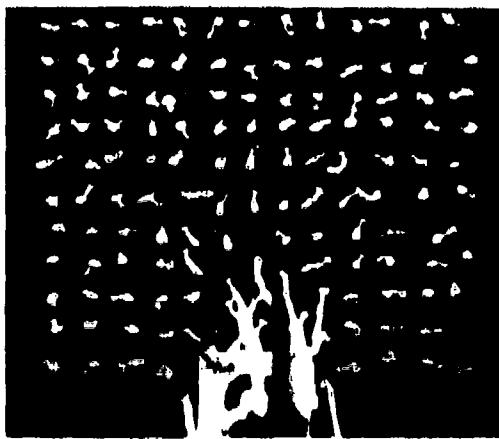


6c. MISSILE I, 33° ROLL, 20° PITCH

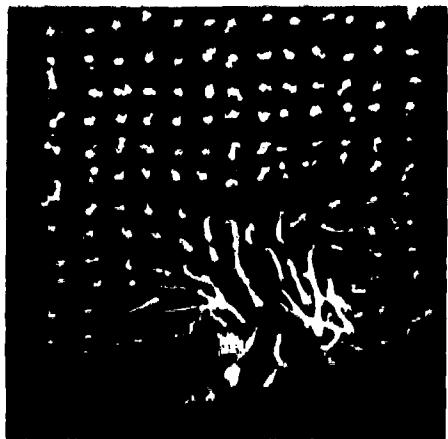


6d. MISSILE I, 45° ROLL, 20° PITCH

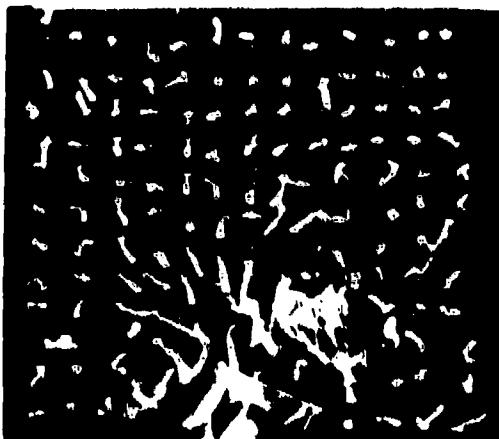
FIGURE D-G. TUFT GRID PHOTOS IN AFT PLANE
FOR MISSILE OF FINENESS RATIO 7.5 .



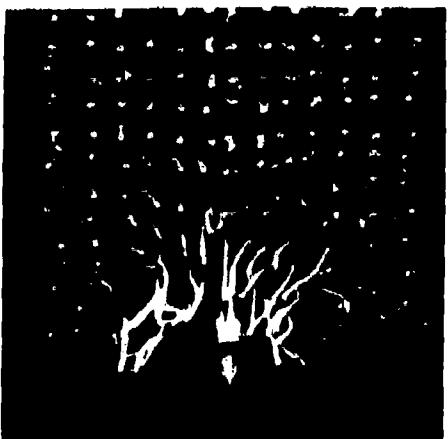
7a. MISSILE I, 0° ROLL, 25° PITCH



7b. MISSILE I, 11° ROLL, 25° PITCH



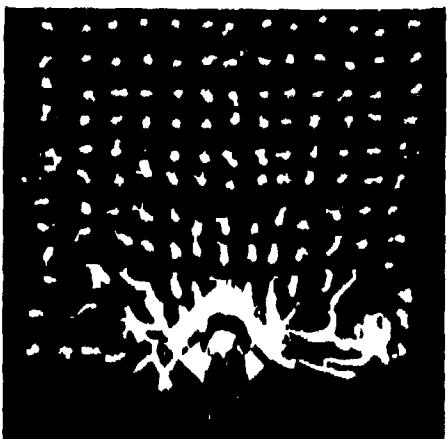
7c. MISSILE I, 22° ROLL, 25° PITCH



7d. MISSILE I, 33° ROLL, 25° PITCH

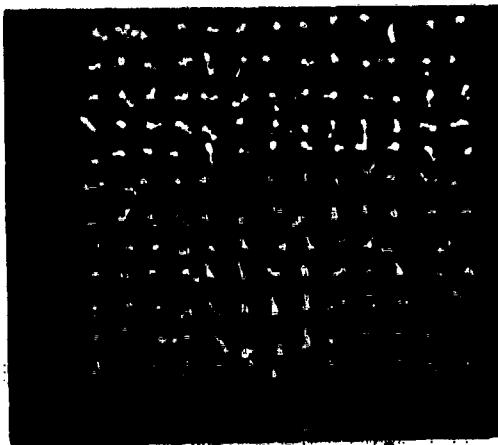


7e. MISSILE I, 45° ROLL, 25° PITCH

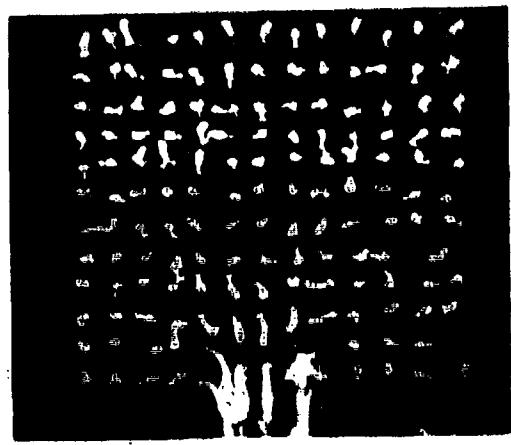


7f. MISSILE I, 45° ROLL, 25° PITCH, FIN CONF.

FIGURE D-7. TUFT GRID PHOTOS IN AFT PLANE
FOR MISSILE OF FINENESS RATIO 7.5.



8a. MISSILE II, 0° ROLL, 10° PITCH



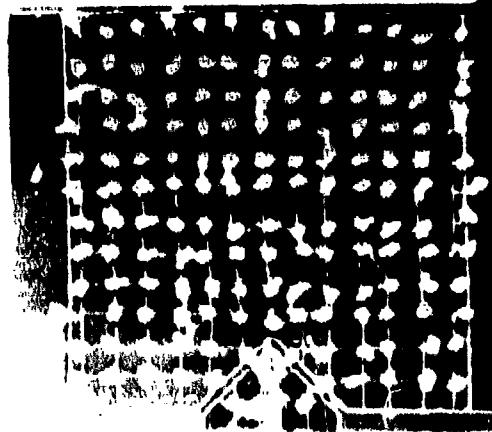
8d. MISSILE II, 0° ROLL, 25° PITCH



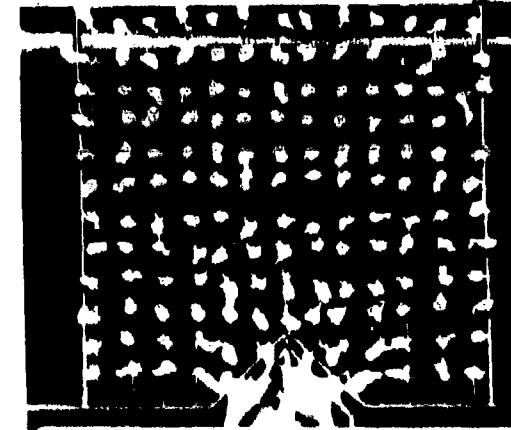
8b. MISSILE II, 22° ROLL, 10° PITCH



8e. MISSILE II, 22° ROLL, 25° PITCH

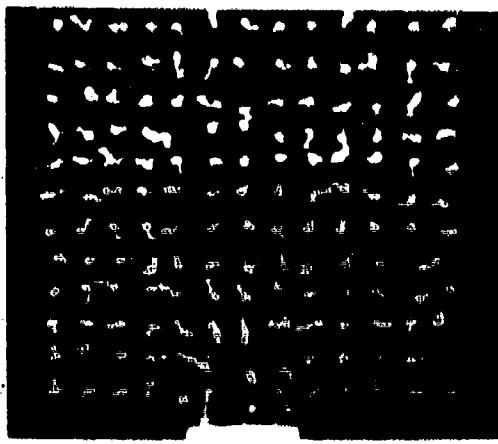


8c. MISSILE II, 45° ROLL, 10° PITCH

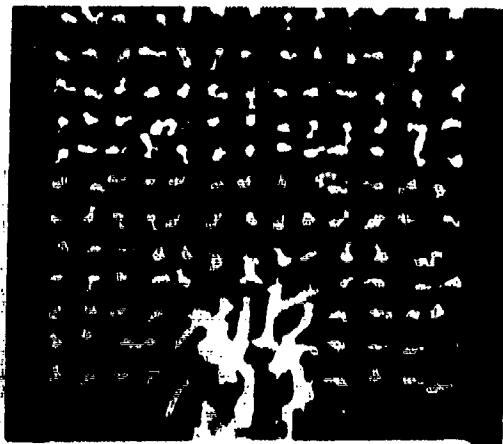


8f. MISSILE II, 45° ROLL, 25° PITCH

FIGURE D-8. TUFT GRID PHOTOS IN FORWARD PLANE
FOR MISSILE OF FINENESS RATIO 7.5 .



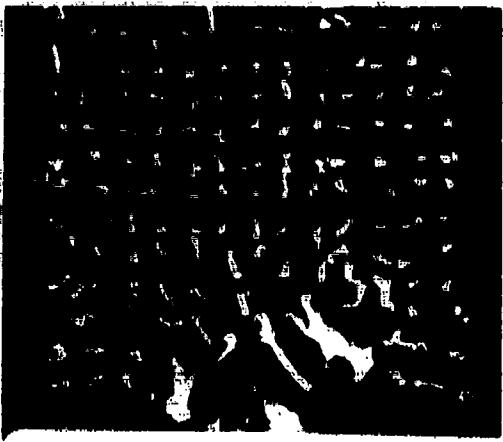
9a. MISSILE II, 0° ROLL, 10° PITCH



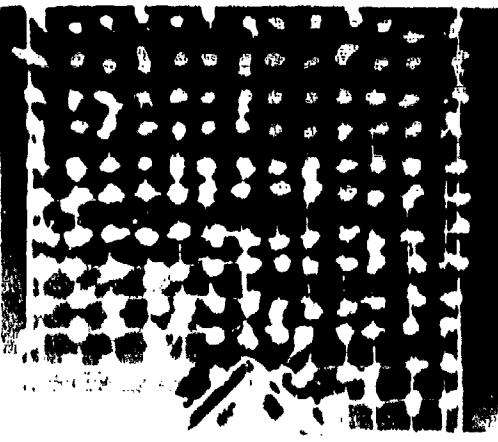
9d. MISSILE II, 0° ROLL, 25° PITCH



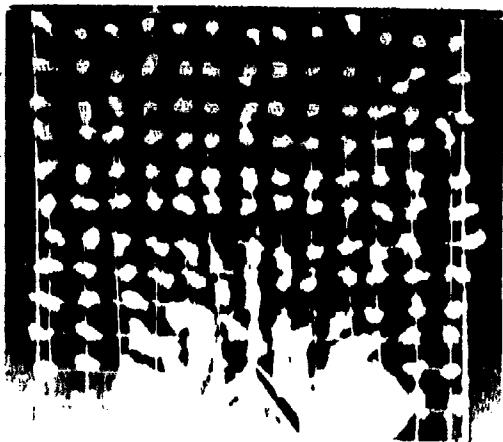
9b. MISSILE II, 22° ROLL, 10° PITCH



9e. MISSILE II, 22° ROLL, 25° PITCH

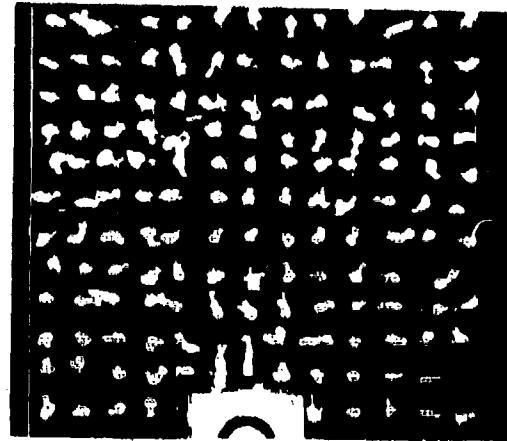


9c. MISSILE II, 45° ROLL, 10° PITCH



9f. MISSILE II, 45° ROLL, 25° PITCH

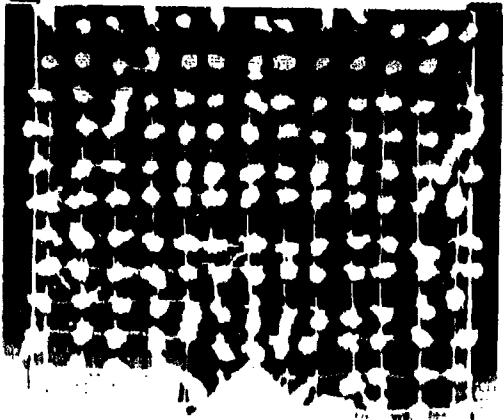
FIGURE D-9. TUFT GRID PHOTOS IN MID PLANE
FOR MISSILE OF FINENESS RATIO 7.5 .



10a. MISSILE II, 0° ROLL, 10° PITCH

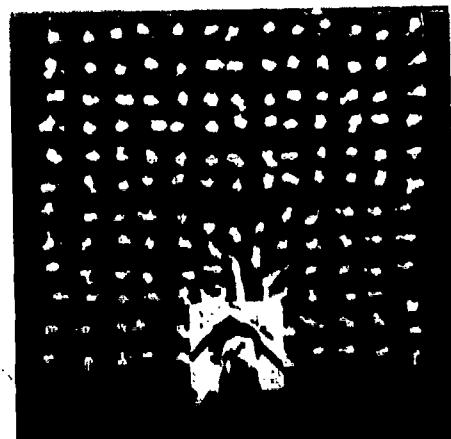


10b. MISSILE II, 22° ROLL, 10° PITCH

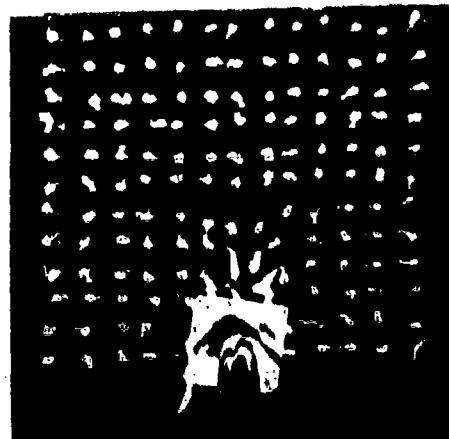


10c. MISSILE II, 45° ROLL, 10° PITCH

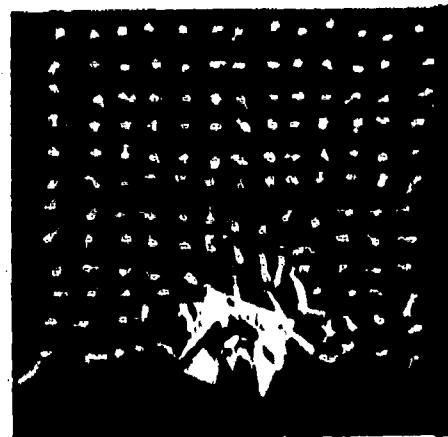
FIGURE D-10. TUFT GRID PHOTOS IN AFT PLANE
FOR MISSILE OF FINENESS RATIO 7.5.



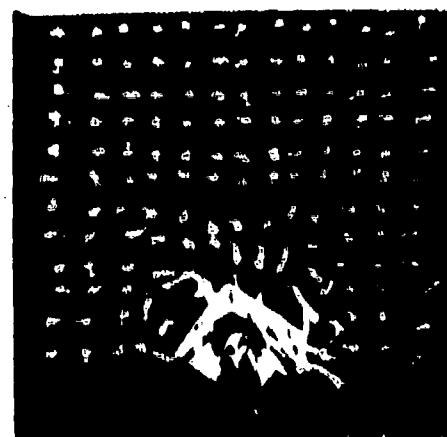
11a. MISSILE II, 0° ROLL, 15° PITCH



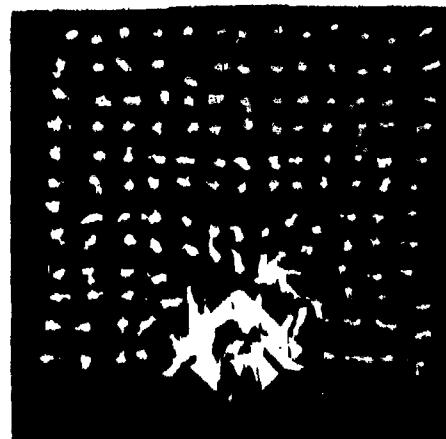
11b. MISSILE II, 11° ROLL, 15° PITCH



11c. MISSILE II, 22° ROLL, 15° PITCH

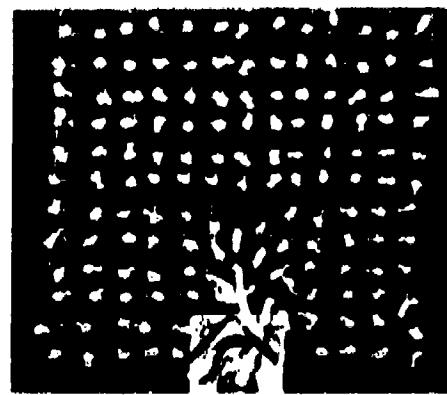


11d. MISSILE II, 33° ROLL, 15° PITCH

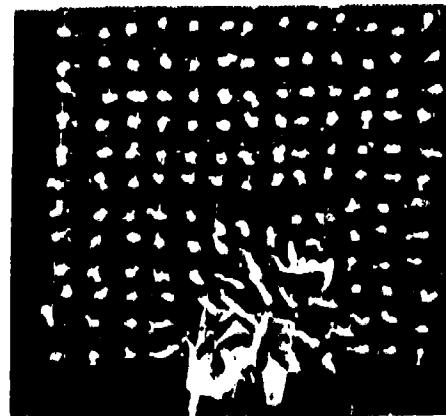


11e. MISSILE II, 45° ROLL, 15° PITCH

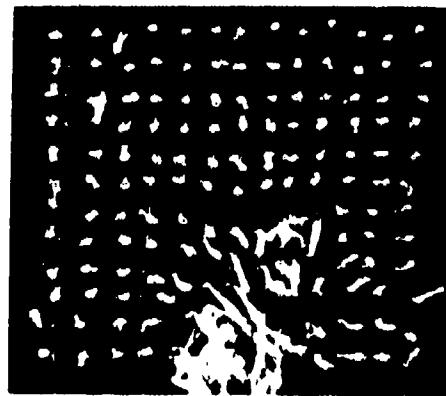
FIGURE D-11. TUFT GRID PHOTOS IN AFT PLANE
FOR MISSILE OF FINENESS RATIO 7.5 .



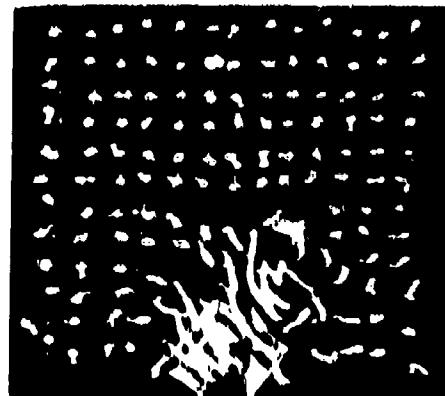
12a. MISSILE 11, 0° ROLL, 20° PITCH



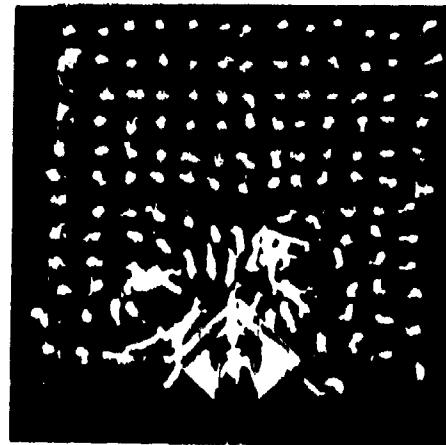
12b. MISSILE 11, 11° ROLL, 20° PITCH



12c. MISSILE 11, 22° ROLL, 20° PITCH



12d. MISSILE 11, 33° ROLL, 20° PITCH

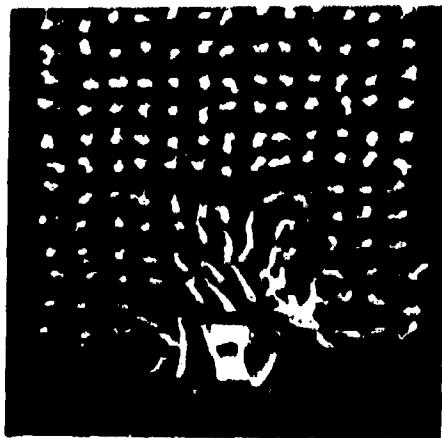


12e. MISSILE 11, 45° ROLL, 20° PITCH

FIGURE D 12. TUFT GRID PHOTOS IN AFI PLANE
FOR MISSILE OF FINENESS RATIO 7.5.



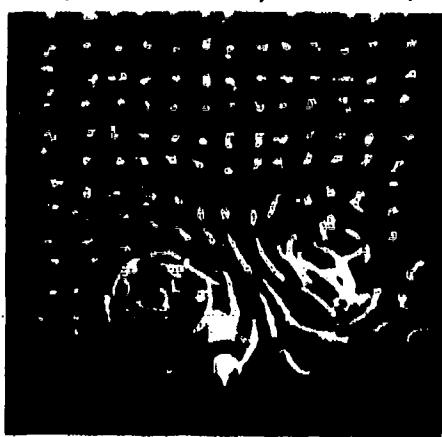
13a. MISSILE II, 0° ROLL, 25° PITCH



13b. MISSILE II, 11° ROLL, 25° PITCH



13c. MISSILE II, 22° ROLL, 25° PITCH

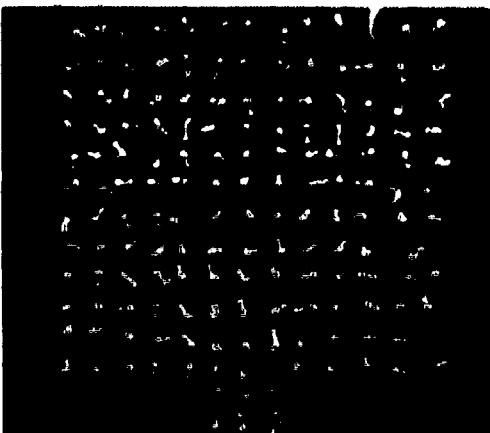


13d. MISSILE II, 33° ROLL, 25° PITCH

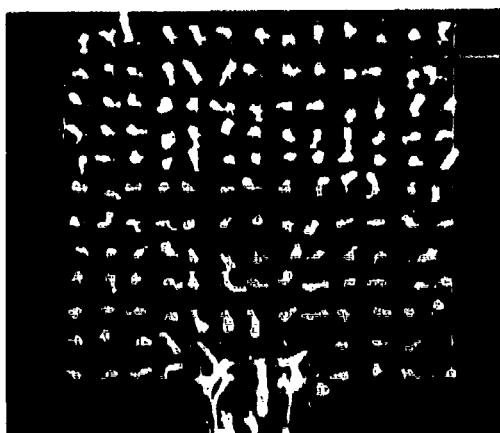


13e. MISSILE II, 45° ROLL, 25° PITCH

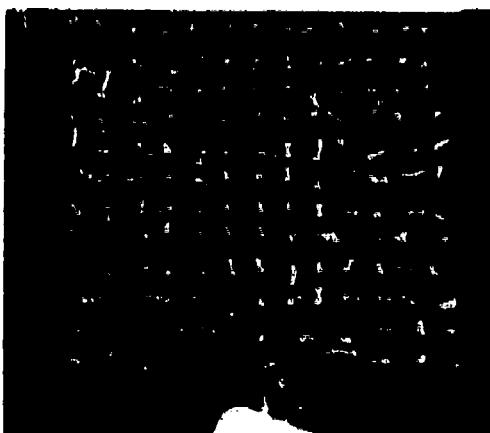
FIGURE D-13 TUFT GRID PHOTOS IN AFT PLANE
FOR MISSILE OF FINNESS RATIO 7.5



14a. MISSILE III, 0° ROLL, 10° PITCH



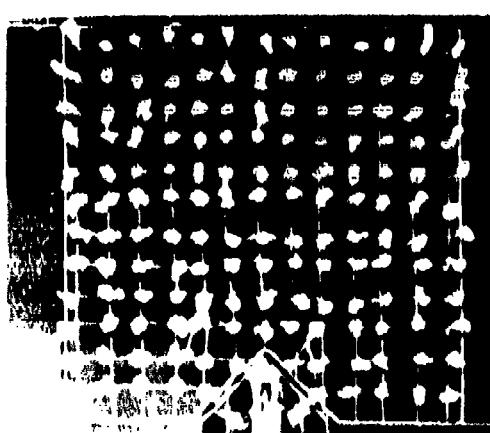
14d. MISSILE III, 0° ROLL, 25° PITCH



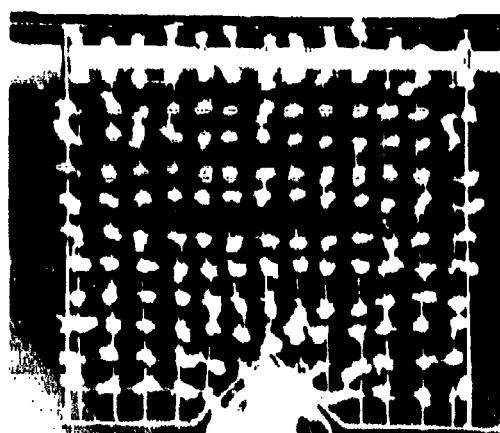
14b. MISSILE III, 22° ROLL, 10° PITCH



14e. MISSILE III, 22° ROLL, 25° PITCH

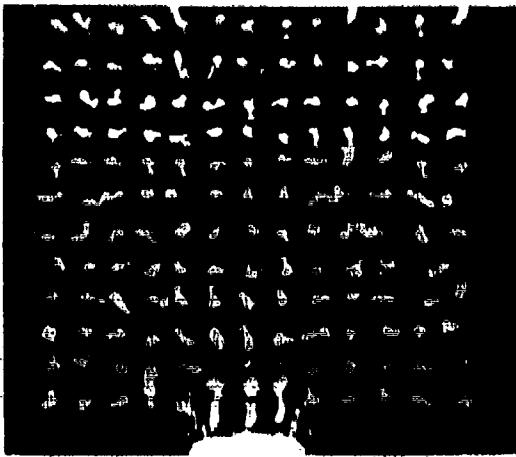


14c. MISSILE III, 45° ROLL, 10° PITCH

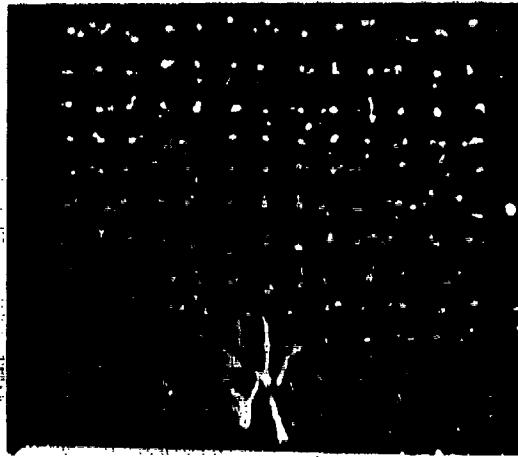


14f. MISSILE III, 45° ROLL, 25° PITCH

FIGURE D-14. TUFT GRID PHOTOS IN FORWARD PLANE
FOR MISSILE OF FINENESS RATIO 7.5



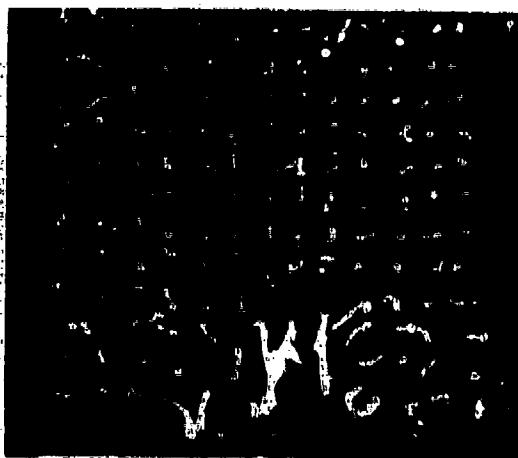
15a. MISSILE III, 0° ROLL, 10° PITCH



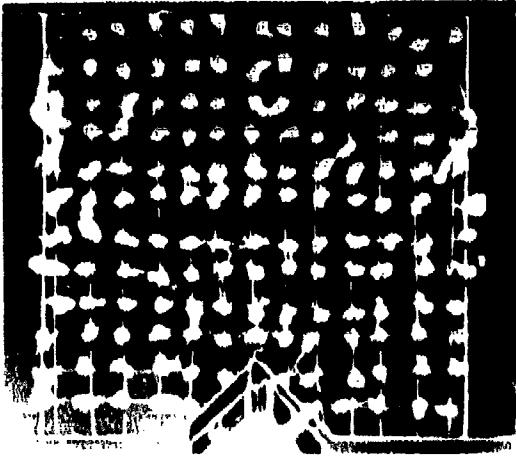
15d. MISSILE III, 0° ROLL, 25° PITCH



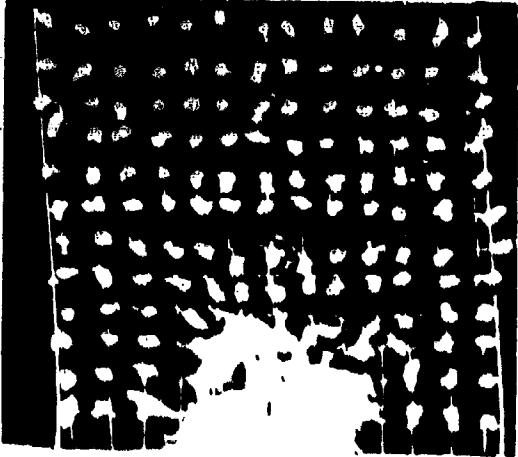
15b. MISSILE III, 22° ROLL, 10° PITCH



15e. MISSILE III, 22° ROLL, 25° PITCH

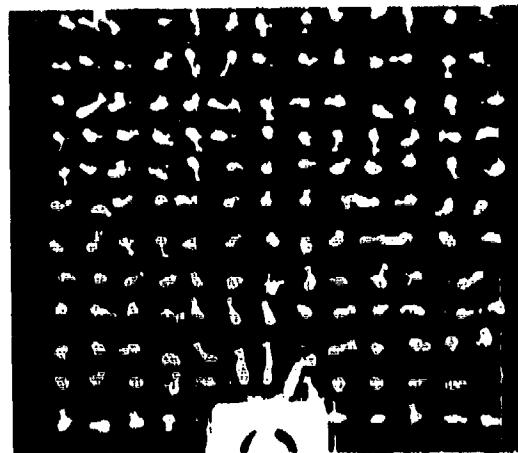


15c. MISSILE III, 45° ROLL, 10° PITCH

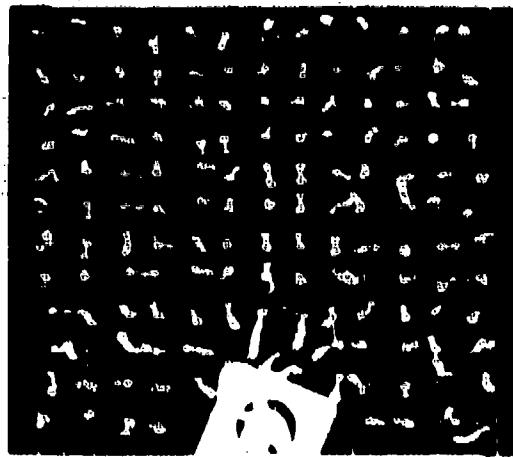


15f. MISSILE III, 45° ROLL, 25° PITCH

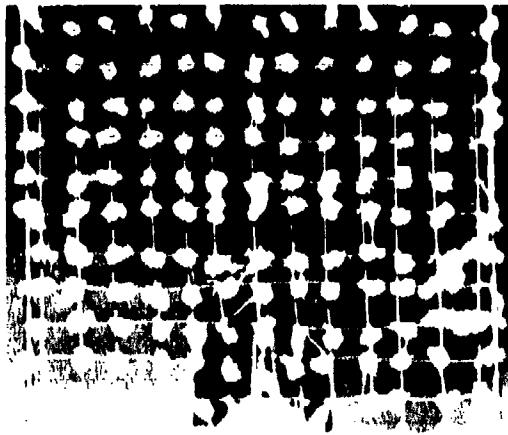
FIGURE D-15 TUFT GRID PHOTOS IN MID PLANE
FOR MISSILE OF FINENESS RATIO 7.5 .



16a. MISSILE III, 0° ROLL, 10° PITCH

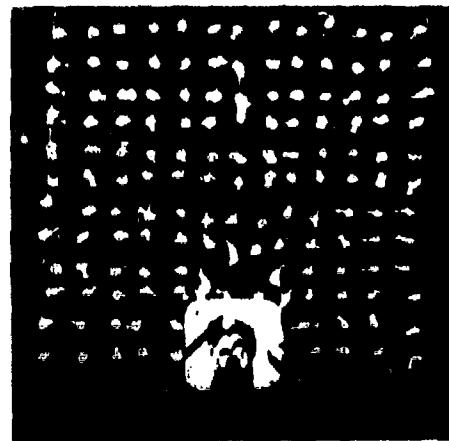


16b. MISSILE III, 22° ROLL, 10° PITCH

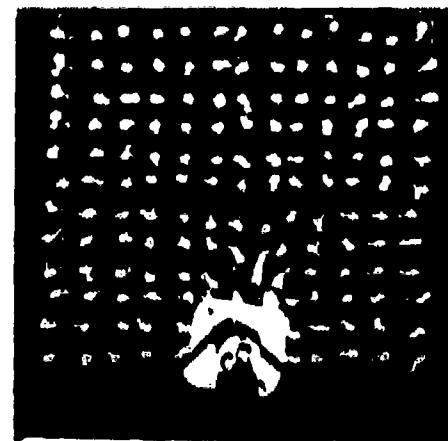


16c. MISSILE III, 45° ROLL, 10° PITCH

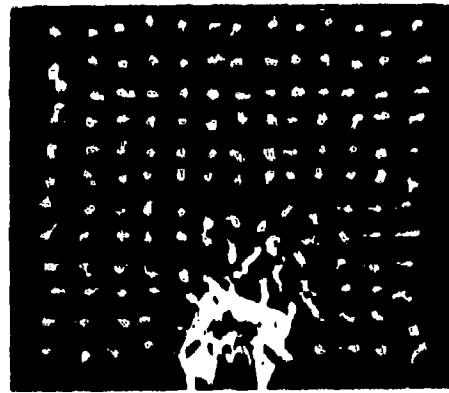
FIGURE D-16. TUFT GRID PHOTOS IN AFT PLANE
FOR MISSILE OF FINENESS RATIO 7.5.



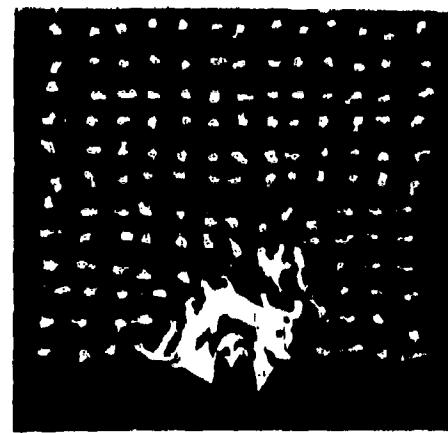
17a. MISSILE III, 0° ROLL, 15° PITCH



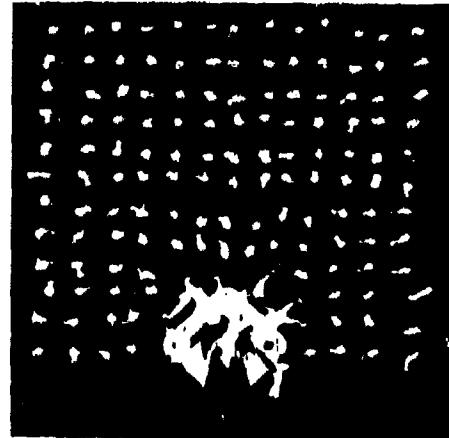
17b. MISSILE III, 11° ROLL, 15° PITCH



17c. MISSILE III, 22° ROLL, 15° PITCH

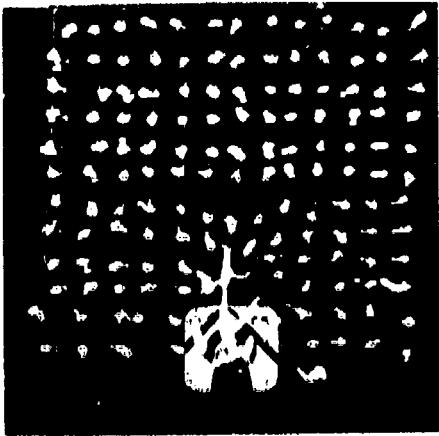


17d. MISSILE III, 33° ROLL, 15° PITCH

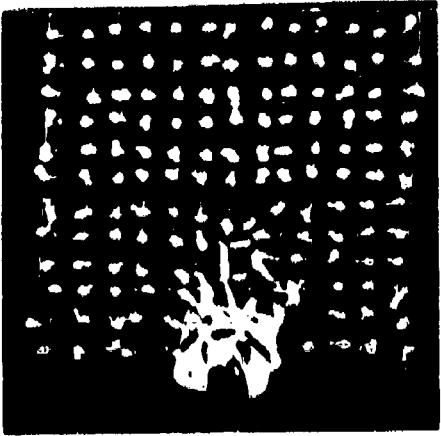


17e. MISSILE III, 45° ROLL, 15° PITCH

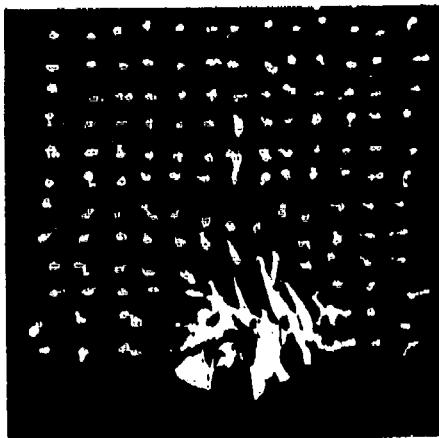
FIGURE D-17 TUFT GRID PHOTOS IN AFT PLANE
FOR MISSILE OF FINENESS RATIO 7.5



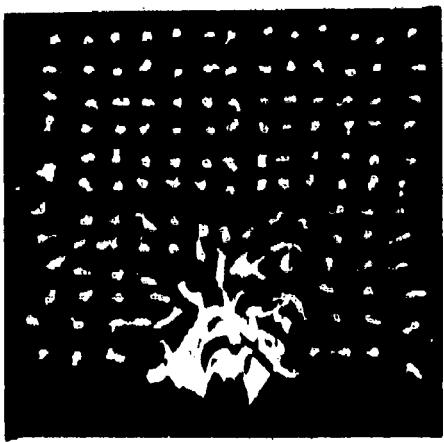
18a. MISSILE III, 0° ROLL, 20° PITCH



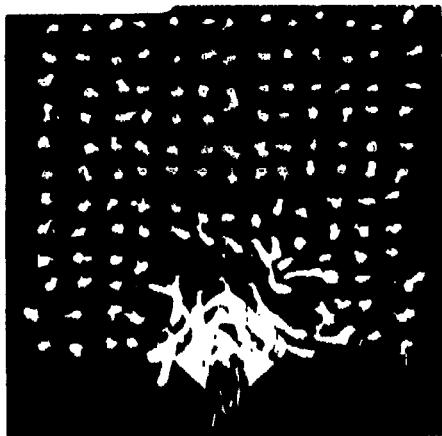
18b. MISSILE III, 11° ROLL, 20° PITCH



18c. MISSILE III, 22° ROLL, 20° PITCH

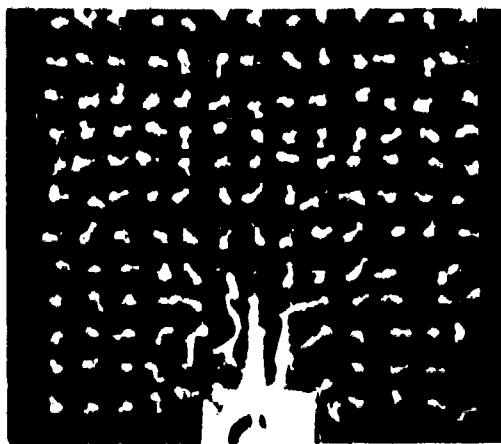


18d. MISSILE III, 33° ROLL, 20° PITCH

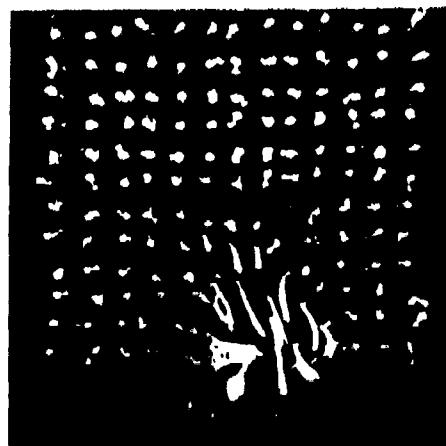


18e. MISSILE III, 45° ROLL, 20° PITCH

FIGURE D-18. TUFT GRID PHOTOS IN AFT PLANE
FOR MISSILE OF FINENESS RATIO 7.5



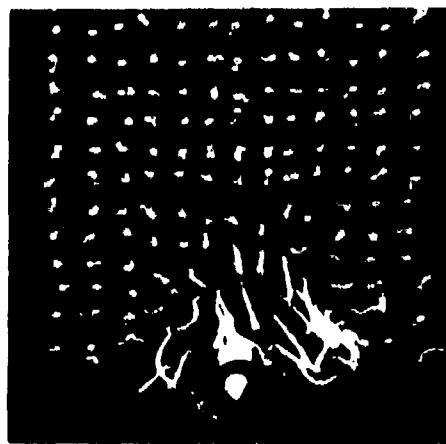
19a. MISSILE III, 0° ROLL, 25° PITCH



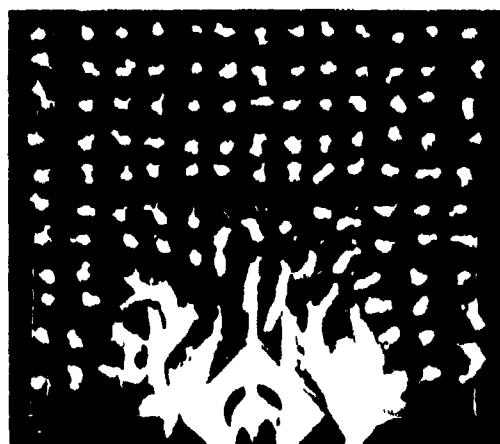
19b. MISSILE III, 11° ROLL, 25° PITCH



19c. MISSILE III, 22° ROLL, 25° PITCH

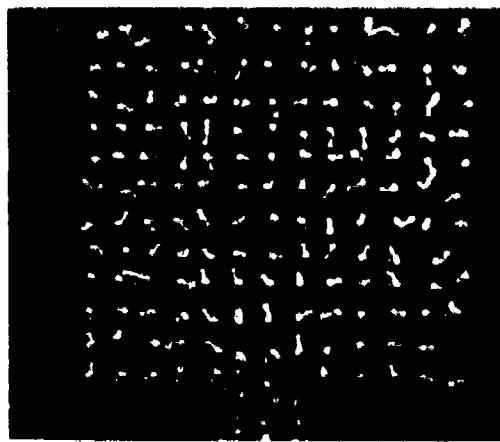


19d. MISSILE III, 33° ROLL, 25° PITCH

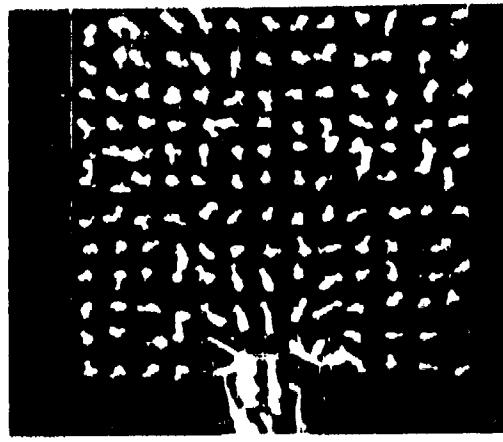


19e. MISSILE III, 45° ROLL, 25° PITCH

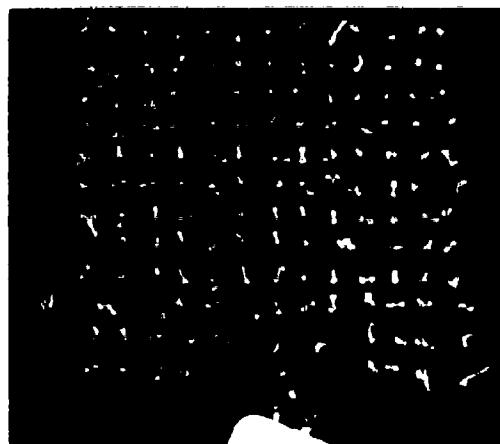
FIGURE D-10a. TUFT GRID PHOTOS IN AEROPLANE
FOR MISSILE OF FINENESS RATIO 7.5



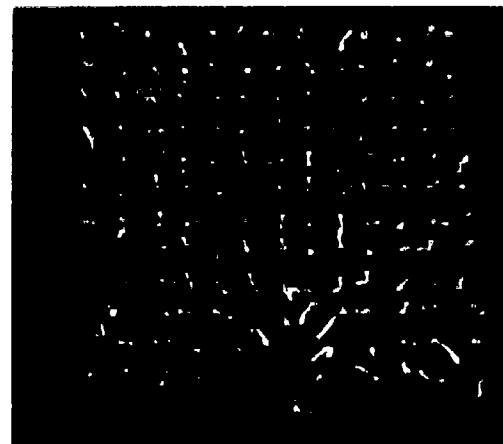
204. LUF T GRID, 10° ROLL, 10° PITCH, 10° YAW



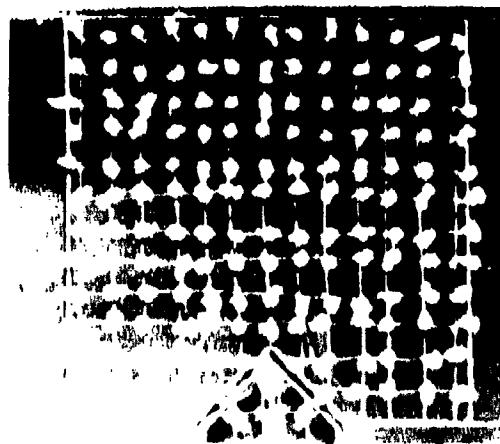
205. LUF T GRID, 10° ROLL, 10° PITCH, 10° YAW



206. LUF T GRID, 10° ROLL, 10° PITCH, 10° YAW



207. LUF T GRID, 10° ROLL, 10° PITCH, 10° YAW

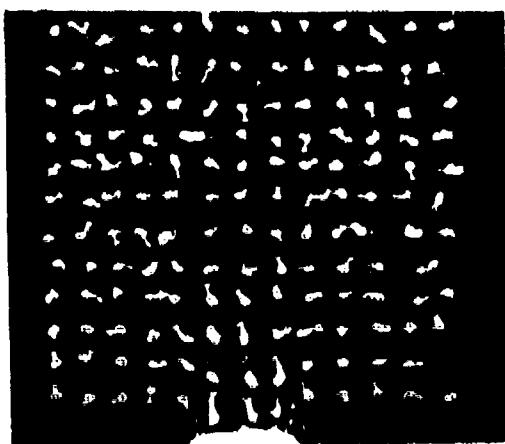


208. LUF T GRID, 10° ROLL, 10° PITCH, 10° YAW

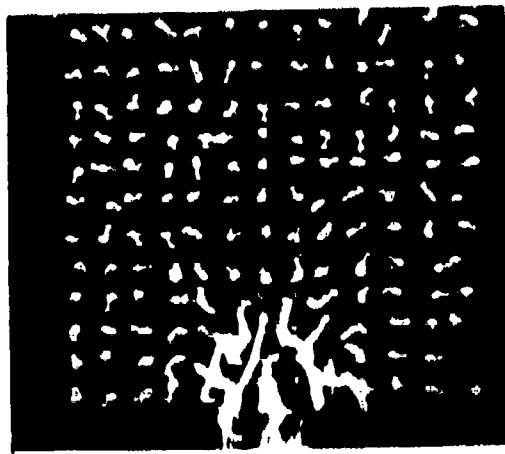


209. LUF T GRID, 10° ROLL, 10° PITCH, 10° YAW

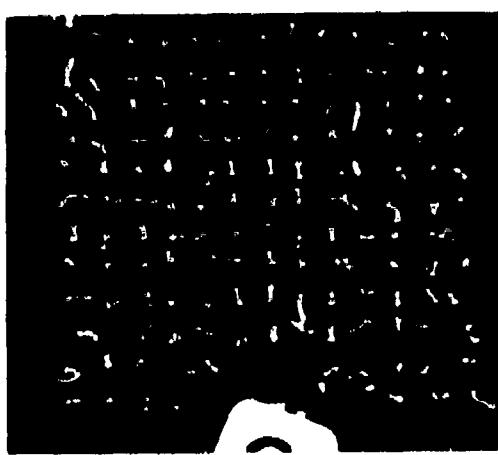
FIGURE D-20. LUF T GRID PHOTOS IN FORWARD PLANE
FOR MEASURE OF ELEMENTS RATIO = 1.0.



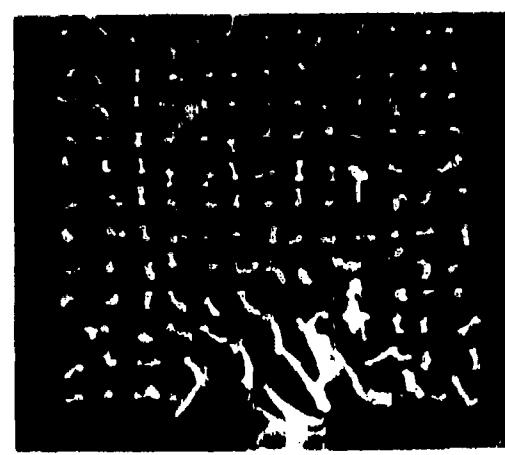
21a. MISSILE T11, 0° ROLL, 10° PITCH, PT. NOSE



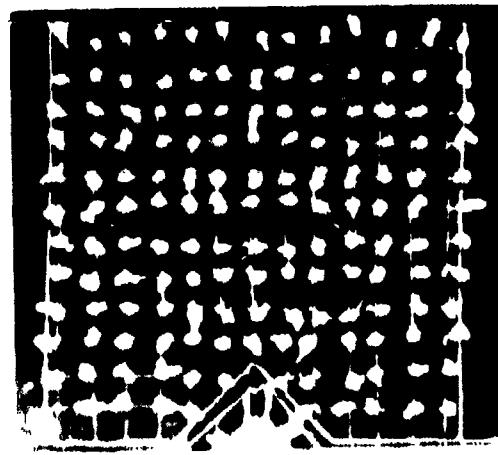
21b. MISSILE T11, 0° ROLL, 25° PITCH, PT. NOSE



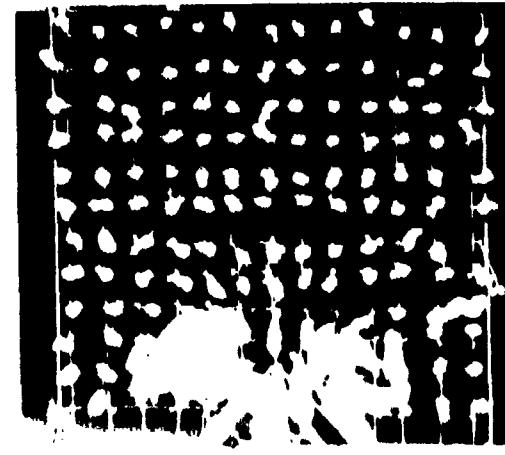
21c. MISSILE T11, 22° ROLL, 10° PITCH, PT. NOSE



21d. MISSILE T11, 22° ROLL, 25° PITCH, PT. NOSE

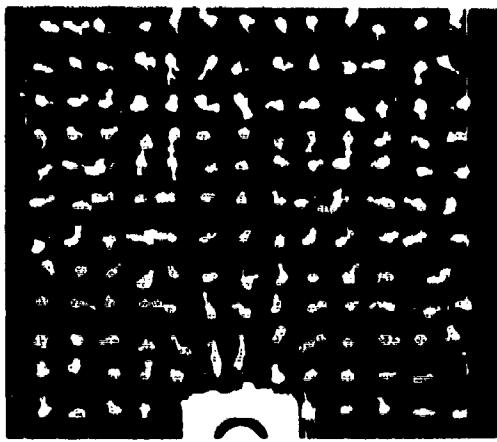


21e. MISSILE T11, 35° ROLL, 10° PITCH, PT. NOSE

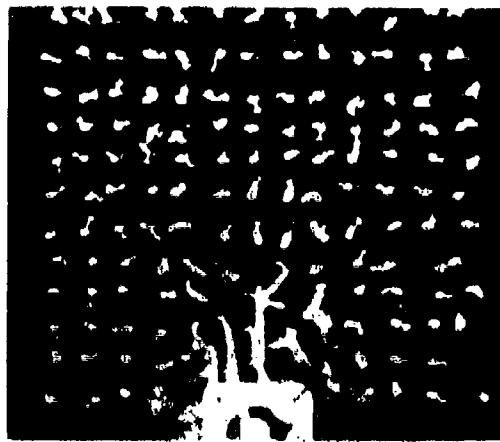


21f. MISSILE T11, 35° ROLL, 25° PITCH, PT. NOSE

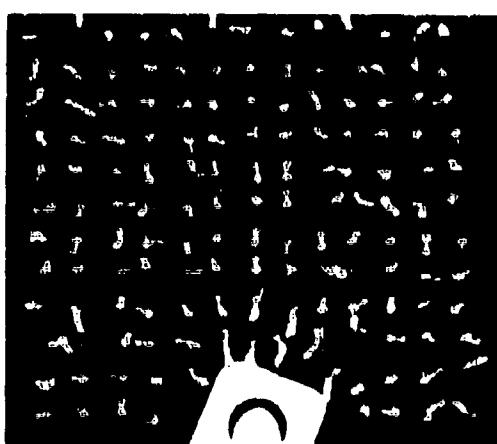
FIGURE D-21. TUFT GRID PHOTOS IN MID PLANE
FOR MISSILE OF FINENESS RATIO 3.0.



22a. MISSILE III, 0° ROLL, 10° PITCH, PT. NOSE



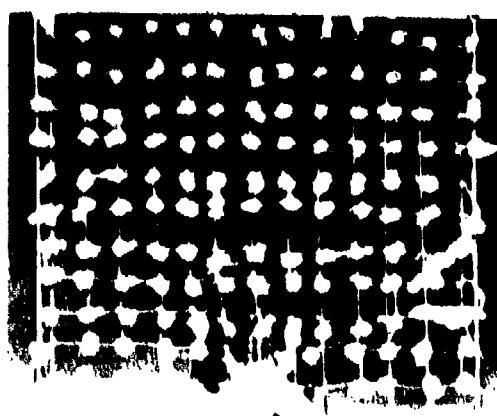
22b. MISSILE III, 0° ROLL, 25° PITCH, PT. NOSE



22c. MISSILE III, 10° ROLL, 10° PITCH, PT. NOSE



22d. MISSILE III, 10° ROLL, 25° PITCH, PT. NOSE

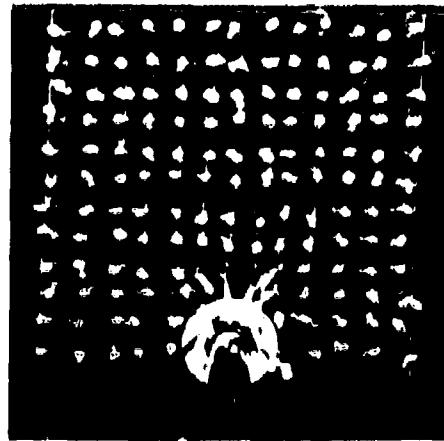


22e. MISSILE III, 20° ROLL, 10° PITCH, PT. NOSE

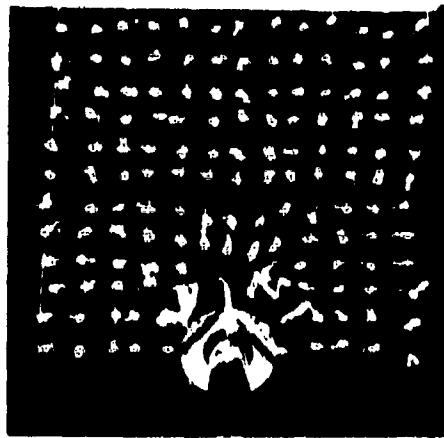


22f. MISSILE III, 20° ROLL, 25° PITCH, PT. NOSE

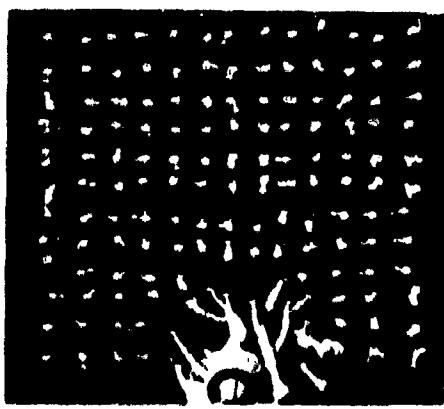
FIGURE D-22. TUFT GRID PHOTOS IN AFT PLANE
FOR MISSILE OF FINENESS RATIO 8.0



23a. MISSILE IV, 0° ROLL, 15° PITCH

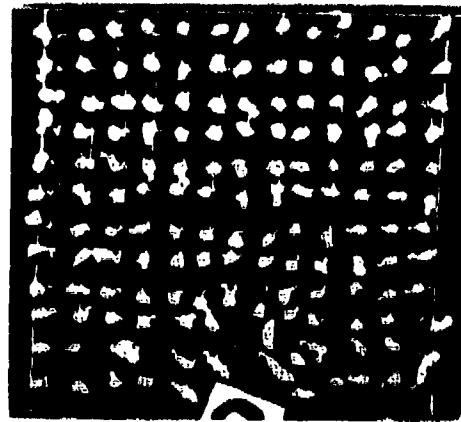


23b. MISSILE IV, 0° ROLL, 20° PITCH

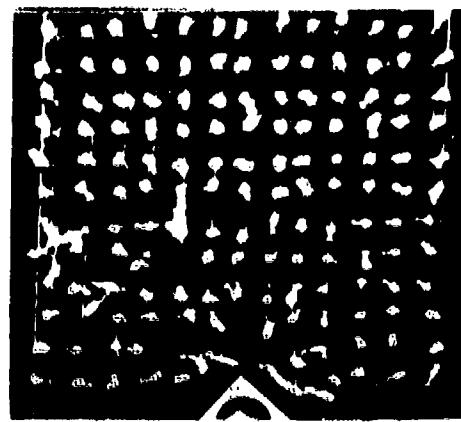


23c. MISSILE IV, 0° ROLL, 25° PITCH

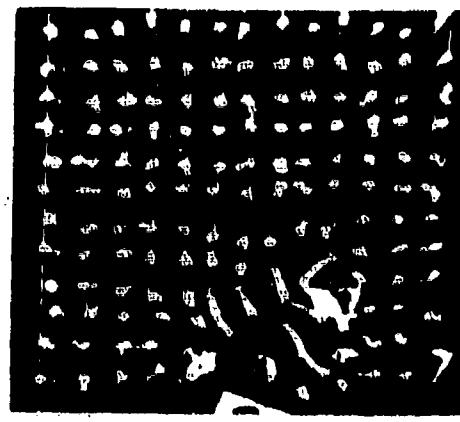
FIGURE D-23. THE THREE PHOTOS IN ARE PLATE
106 AND 155 FOR ONE POSITION OF THE AIR TO MISSILE



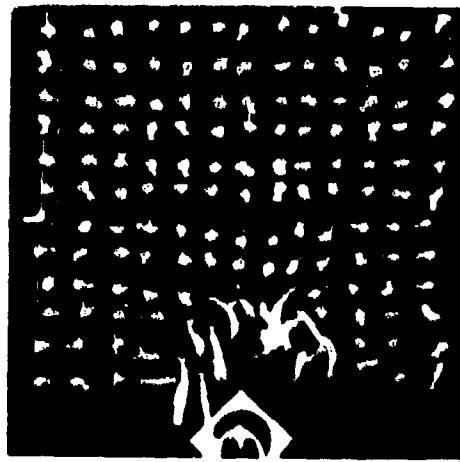
24a. MISSILE 1, 22° ROLL, 10° PITCH



24b. MISSILE 1, 45° ROLL, 10° PITCH

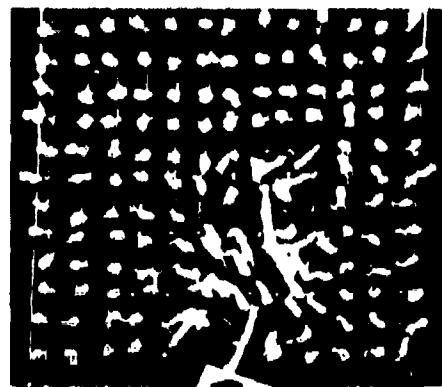


24c. MISSILE 1, 22° ROLL, 15° PITCH

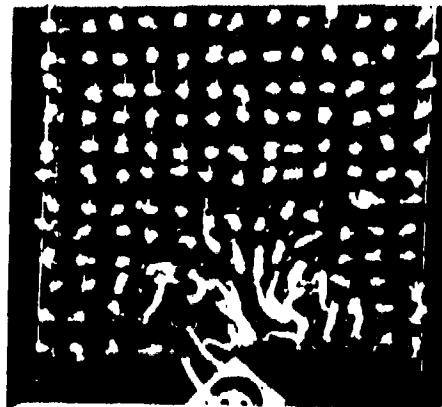


24d. MISSILE 1, 45° ROLL, 15° PITCH

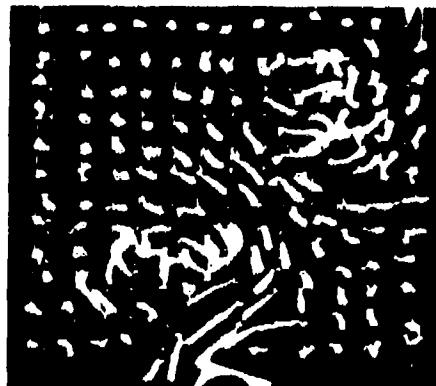
FIGURE D-24. TUFT GRID PHOTOS IN AFT PLANE
FOR MISSILE OF FINENESS RATIO 15.33.



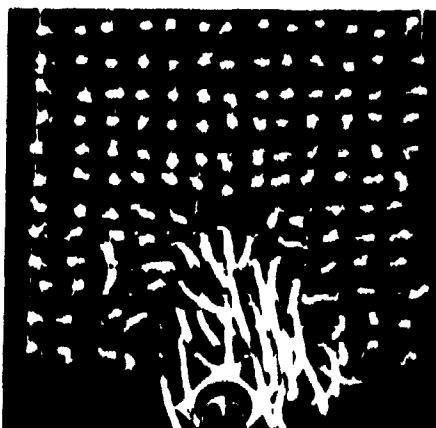
25a. MISSILE 1, 22° ROLL, 20° PITCH



25b. MISSILE 1, 45° ROLL, 20° PITCH

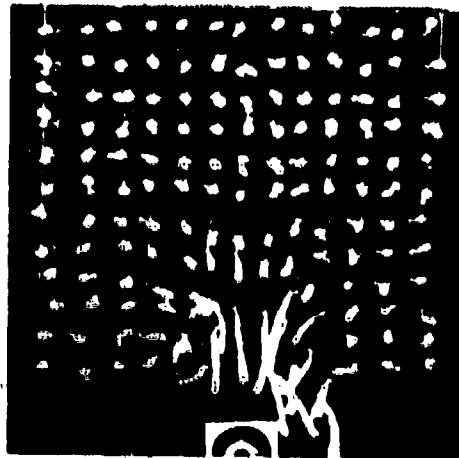


25c. MISSILE 1, 44° ROLL, 25° PITCH



25d. MISSILE 1, 45° ROLL, 35° PITCH

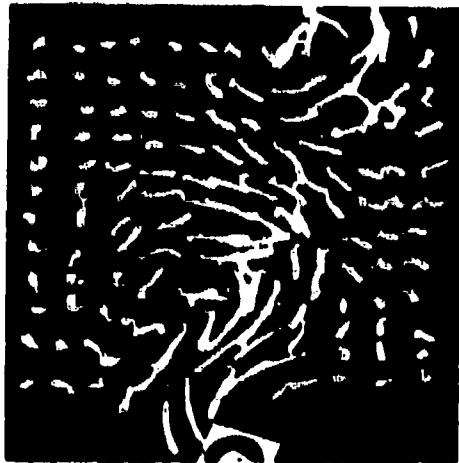
FIGURE D-25. EXTENDED PHOTON FIELD PLOTS FOR MISSILE 1, 0° PITCH, 0° AFT PLANE FOR MISSILE 1, 0° PITCH, 0° AFT PLANE



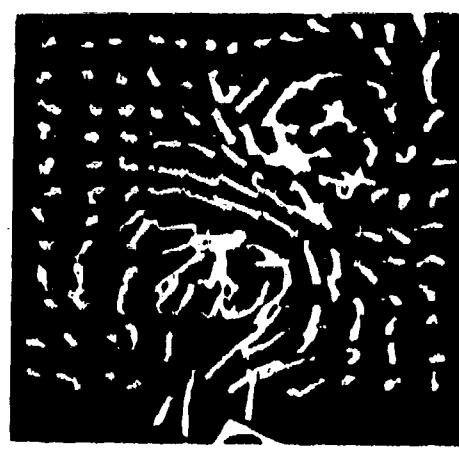
26a. MISSILE 1, 0° ROLL, 30° PITCH



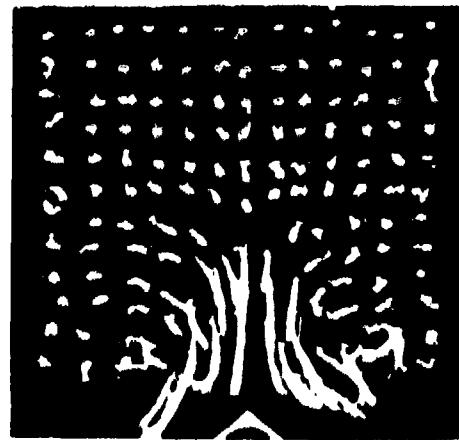
26b. MISSILE 1, 11° ROLL, 30° PITCH



26c. MISSILE 1, 22° ROLL, 30° PITCH

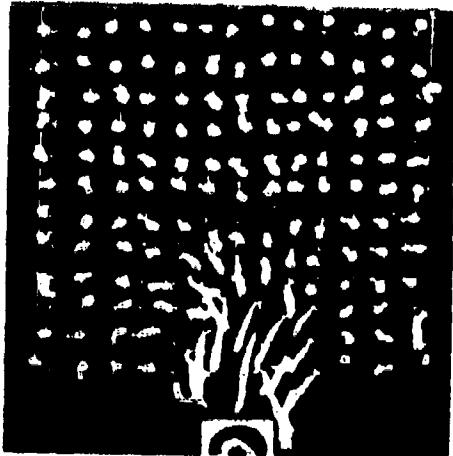


26d. MISSILE 1, 33° ROLL, 30° PITCH

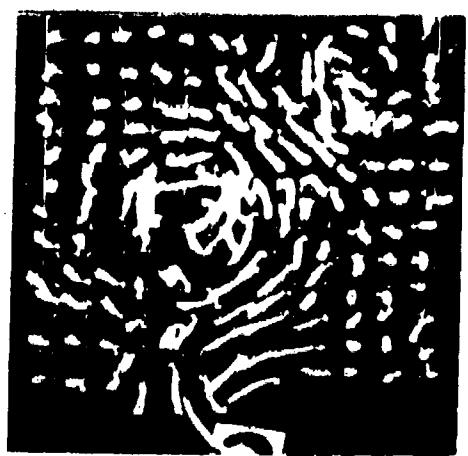


26e. MISSILE 1, 45° ROLL, 30° PITCH

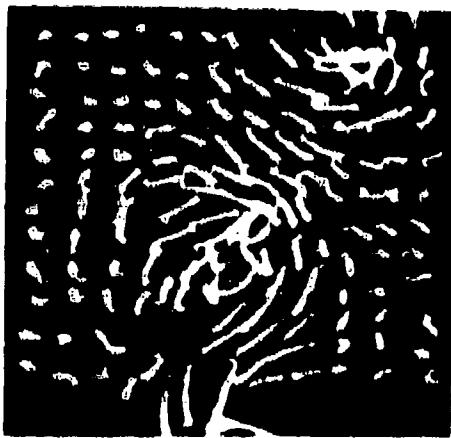
FIGURE D-26. TUFT GRID PHOTOS IN AFT PLANE
FOR MISSILE OF FINENESS RATIO 15, 33.



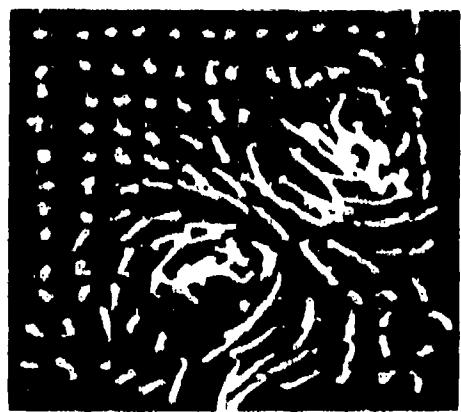
27a. MISSILE 2, 0° ROLL, 30° PITCH



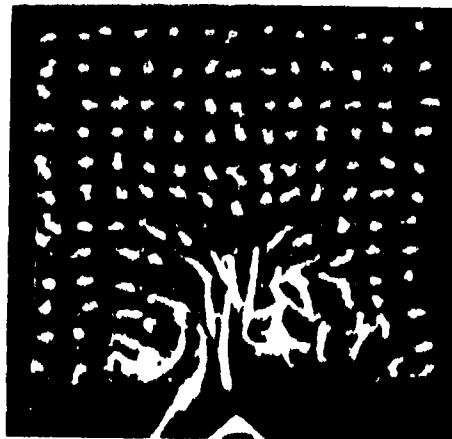
27b. MISSILE 2, 11° ROLL, 30° PITCH



27c. MISSILE 2, 22° ROLL, 30° PITCH

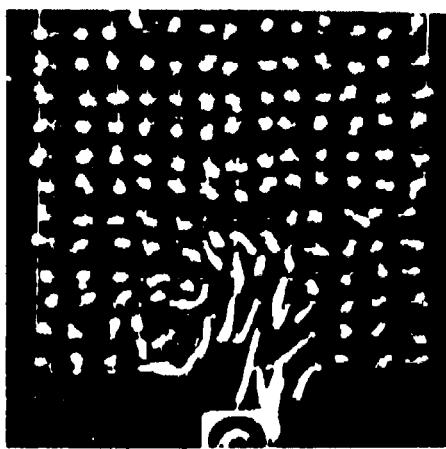


27d. MISSILE 2, 33° ROLL, 30° PITCH



27e. MISSILE 2, 45° ROLL, 30° PITCH

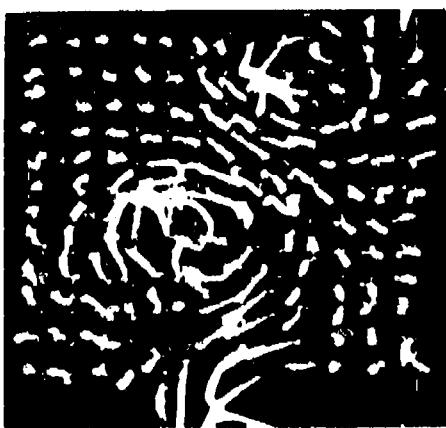
FIGURE 0-27. UNEDITED PHOTOS IN AIR PRESS
FOR MISSILE 2 (EFFICIENCY RATIO = 1.0).



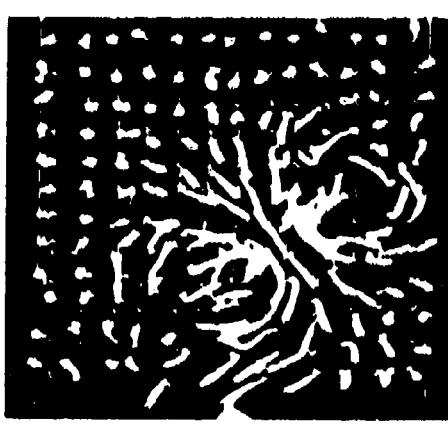
28a. MISSILE 3, 0° ROLL, 30° PITCH



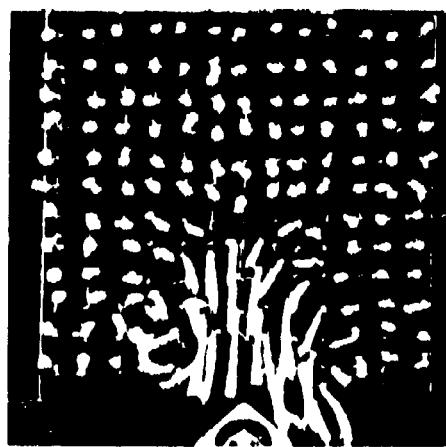
28b. MISSILE 3, 11° ROLL, 30° PITCH



28c. MISSILE 3, 22° ROLL, 30° PITCH

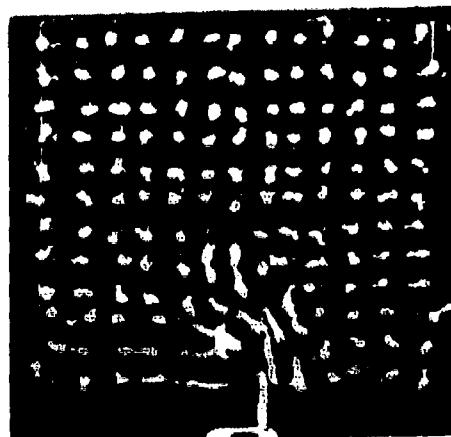


28d. MISSILE 3, 33° ROLL, 30° PITCH

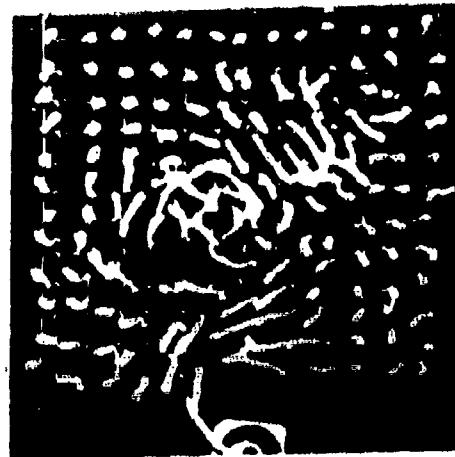


28e. MISSILE 3, 45° ROLL, 30° PITCH

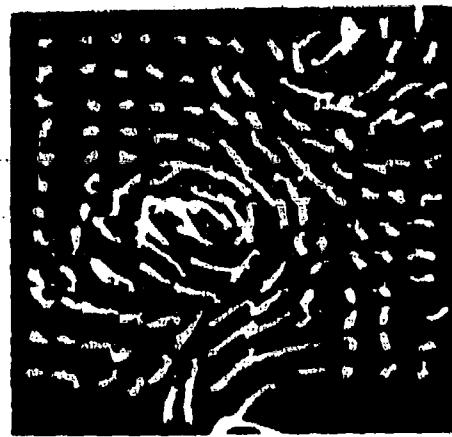
Fig. 28. Effect of roll angle on the pattern of the AIIA plane
when the roll angle is greater than the AIIA angle.



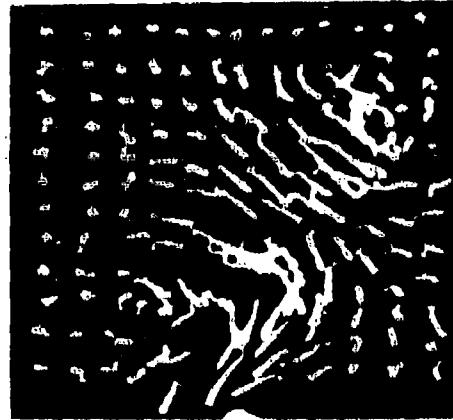
29a. MISSILE 4, 0° ROLL, 30° PITCH



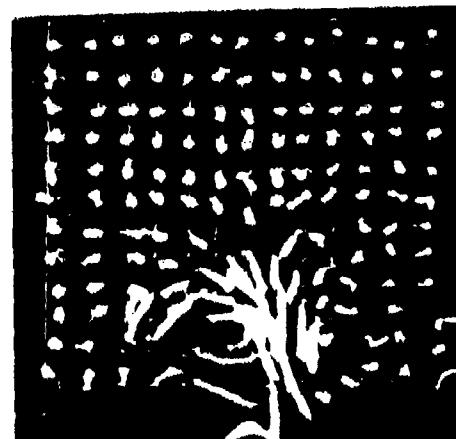
29b. MISSILE 4, 11° ROLL, 30° PITCH



29c. MISSILE 4, 22° ROLL, 30° PITCH

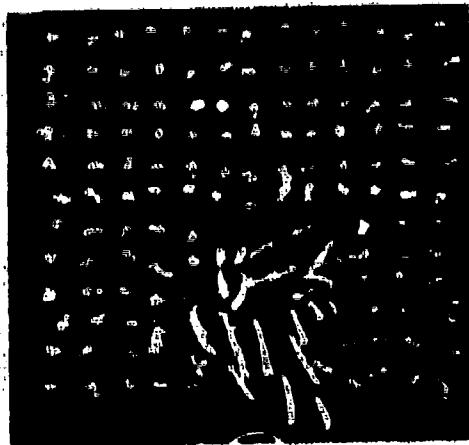


29d. MISSILE 4, 33° ROLL, 30° PITCH



29e. MISSILE 4, 45° ROLL, 30° PITCH

FIGURE D-29. TUFT GRID PHOTOS IN AFT PLANE
FOR MISSILE OF FINENESS RATIO 15.33.



30a. MISSILE 5, 0° ROLL, 30° PITCH

FIGURE D-30. TUFT GRID PHOTOS IN AFT PLANE
FOR MISSILE OF FINENESS RATIO 15.33 .

APPENDIX E

OIL FLOW PATTERNS

Oil flow tests were conducted on missiles of fineness ratio 8 and 16 in the subsonic wind tunnel at a freestream velocity of 360 fps. Photographs were recorded of the oil patterns for the missiles tested at various configurations and orientations and are illustrated in Figures E-1 through E-41. All tests were conducted of missiles without fins.

Oil flow tests were conducted as follows. After painting the models black, a white oil (mixture of titanium dioxide, oleic acid and 90 weight transmission oil) was sprayed in a speckled pattern on the surface of each model. The models were placed on the sting, and the wind tunnel was run for approximately 2 minutes--the time required for the oil to migrate over the surface of the models. Photographs of the upper, right and left sides of the models were then taken for the various missile configurations and orientations tested.

For missiles of fineness ratio 8, each of the 4 bodies was tested with the blunt nose at 10, 15, 20, and 25 degrees pitch and 0, 11, 22, 33, and 45 degrees roll. The 20% corner radius body was also tested with the pointed nose at 10, 15, 20, and 25 degrees

pitch and 0, 22, and 45 degrees roll. A test matrix of the various missile configurations and orientations is shown in Table E-1.

For missiles of fineness ratio 16, each of the 5 bodies was tested with the blunt nose at 30 degrees pitch and 0 and 22 degrees roll. In addition, the 20 $\frac{1}{4}$ corner radius body was also tested at 30 degrees pitch and 11, 33, and 45 degrees roll. Table E-2 shows the configurations and orientations tested for missiles of fineness ratio 16.

Figures E-1 and E-41 show oil flow patterns on the top, left and right surfaces for the various missile configurations and orientations tested. Each of the three views (top, left, and right) of the model are defined looking upstream. However, at the completion of each test to facilitate the photography, the models were rolled 90 degrees and 180 degrees prior to taking photographs of the top and right views, respectively. To help eliminate confusion, a schematic of the cross-flow plane during the experiment and during the photography is shown on Figure E.01.

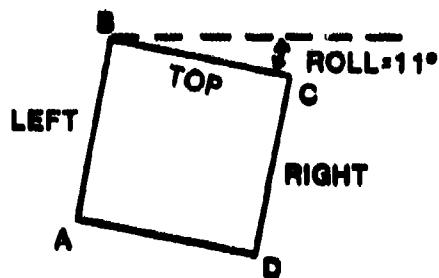


Figure E.01A.

Position of Model at 11 Degrees Roll During Wind Tunnel Experiment ($\phi = 11$ Degrees)

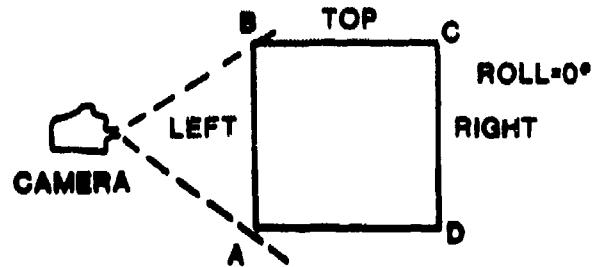


Figure E.01B.

Position of Model during Photography of Left Side ($\phi = 0$ Degrees)

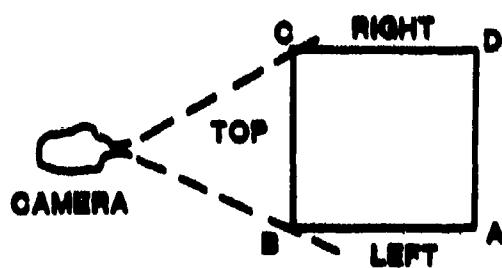


Figure E.01C.

Position of Model during Photography of Top Side ($\phi = -90$ Degrees)

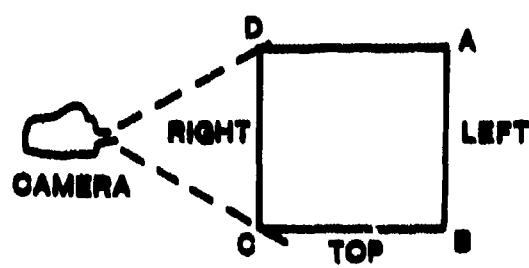


Figure E.01D.

Position of Model during Photography of Right Side ($\phi = -180$ Degrees)

Figure E.01. Positions of Missile During Wind Tunnel Experiments and Photography. View Looking Upstream (at Aft End of Missile)

TABLE E-1

OIL FLOW PATTERNS FOR MISSILES OF FIGURES RATIO 8

Body Configuration	Nose Shape	Pitch Angle	Roll Angle	Figure
I	WL	10°, 15°	0°	E-1
I	HL	20°, 25°	0°	E-2
I	BL	15°, 20°	11°	E-3
I	HL	10°, 25°	11°	E-4
I	BL	15°, 20°	22°	E-5
I	HL	25°, 15°	22°, 33°	E-6
I	HL	20°, 25°	33°	E-7
I	BL	10°, 15°	45°	E-8
I	BL	20°, 25°	45°	E-9
I	BL	10°, 15°	0°	E-10
II	BL	20°, 25°	0°	E-11
II	BL	15°, 20°	11°	E-12
II	BL	25°, 10°	11°, 22°	E-13
II	BL	15°, 20°	22°	E-14
II	BL	25°, 15°	22°, 33°	E-15
II	BL	20°, 25°	33°	E-16
II	BL	10°, 15°	45°	E-17
II	BL	20°, 25°	45°	E-18
III	BL	10°, 15°	0°	E-19
III	BL	20°, 25°	0°	E-20
III	BL	15°, 20°	11°	E-21
III	BL	25°, 10°	11°, 22°	E-22

TABLE E-1
OIL FLOW PATTERNS FOR MISSILES OF FINETESS RATIO 8

Body* Configuration	Nose** Shape	Pitch Angle	Roll Angle	Figure
III	BL	15°, 20°	22°	E-23
III	BL	25°, 15°	22°, 33°	E-24
III	BL	20°, 25°	33°	E-25
III	BL	10°, 15°	45°	E-26
III	BL	20°, 25°	45°	E-27
IV	BL	10°, 15°	0°	E-28
IV	BL	20°, 25°	0°	E-29
III	PT	20°, 25°	0°	E-30
III	PT	10°, 15°	0°	E-31
III	PT	10°, 15°	22°	E-32
III	PT	20°, 25°	22°	E-33
III	PT	10°, 15°	45°	E-34
III	PT	20°, 25°	45°	E-35

*Body Shapes

- I - Square
- II - 10 Δ Corner Radius
- III - 20 Δ Corner Radius
- IV - Round

**Nose Shapes

- BL - Blunt Nose
- PT - Pointed Nose

TABLE E-2
OIL FLOW PATTERNS FOR MISSILES OF FINNESS RATIO 16

<u>Body* Configuration</u>	<u>Nose* Shape</u>	<u>Pitch Angle</u>	<u>Roll Angle</u>	<u>Figure</u>
1	BL	30°	6°, 22°	E-36
2	BL	30°	0°, 22°	E-37
3	BL	30°	0°, 11°	E-38
3	BL	30°	22°, 33°	E-39
3,4	BL	30°	45°, 0°	E-40
4,5	BL	30°	22°, 0°	E-41

*Body Configuration

- 1 - Square
- 2 - 10° Corner Radius
- 3 - 20° Corner Radius
- 4 - 30° Corner Radius
- 5 - Round

*Nose Shape

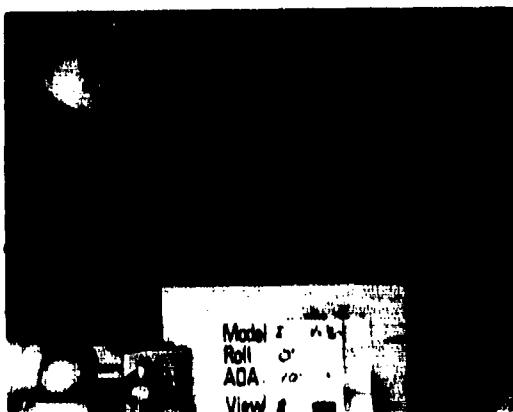
- BL - Blunt Nose
- PT - Pointed Nose



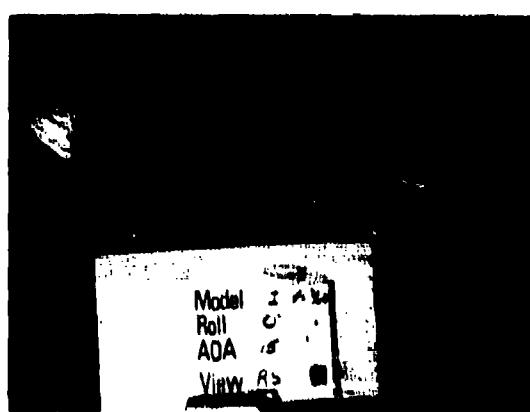
1a. PICTURE A- LEFT SIDE VIEW



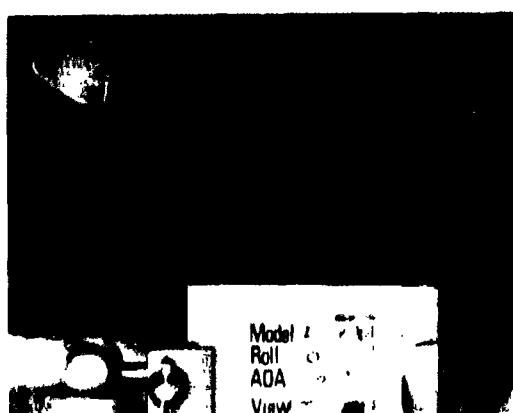
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOP SIDE VIEW

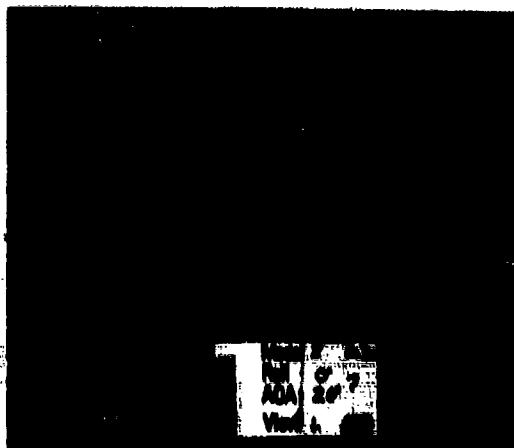
COLUMN 1, MISSILE 1, 0° ROLL, 10° AOA.



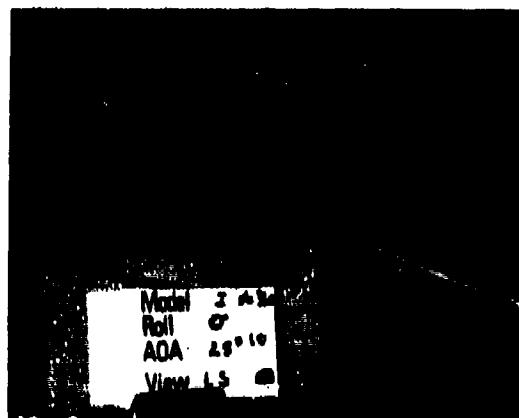
2c. PICTURE F- TOP SIDE VIEW

COLUMN 2, MISSILE 1, 0° ROLL, 0° AOA.

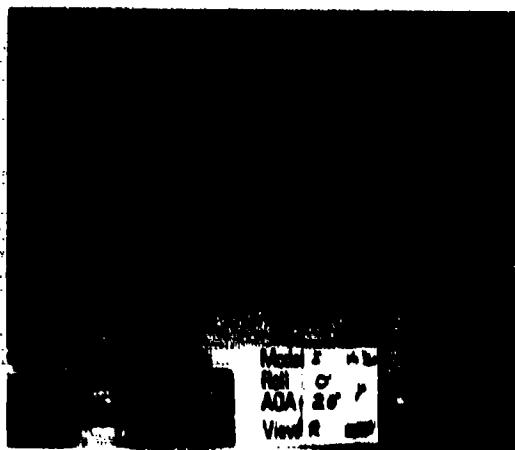
FIGURE E-1. OIL FLOW VISUALIZATION PHOTOGRAPHS



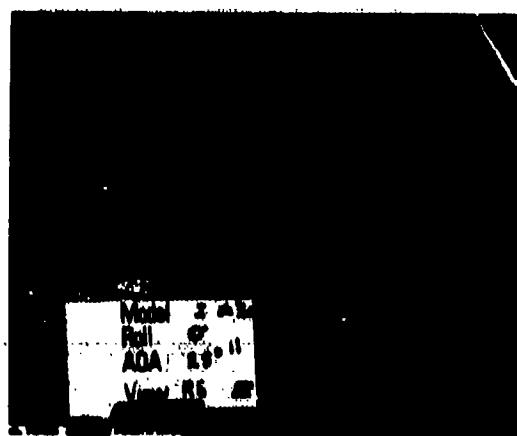
1a. PICTURE A- LEFT SIDE VIEW



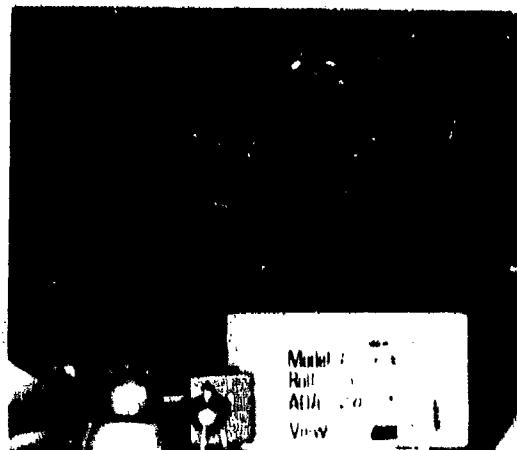
2a. PICTURE D- LEFT SIDE VIEW



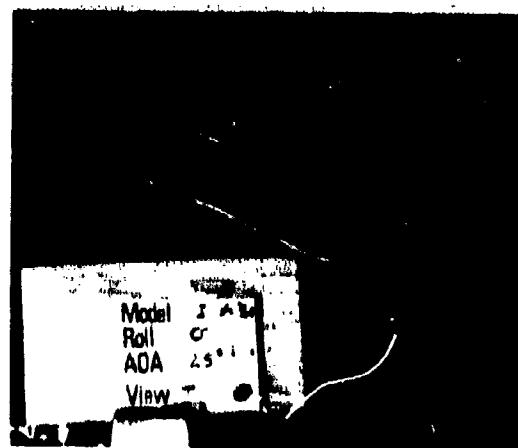
1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

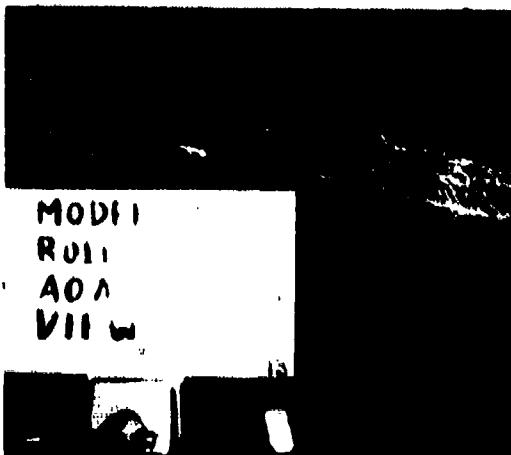


2c. PICTURE F- TOPSIDE VIEW

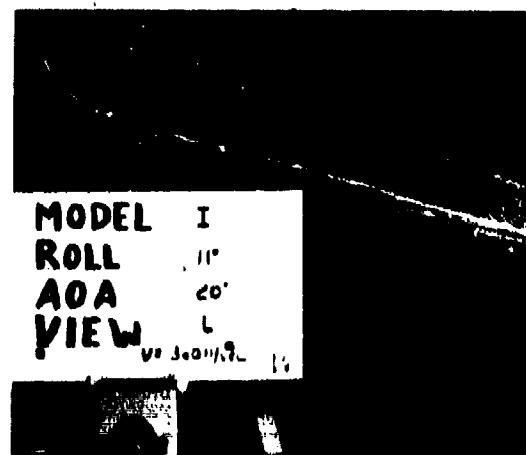
COLUMN 1. MISSILE 1, 0° ROLL, 20° AOA

COLUMN 2. MISSILE 1, 0° ROLL, 25° AOA

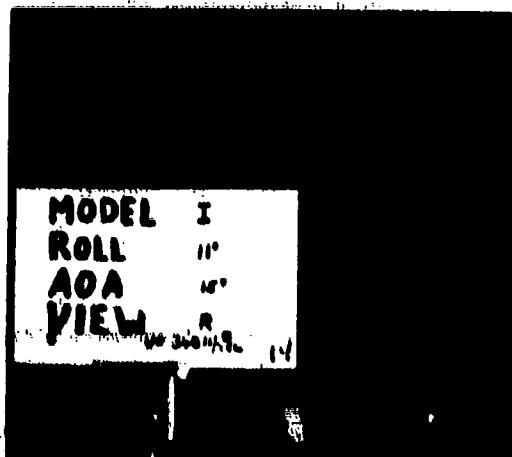
FIGURE E-2. OIL FLOW VISUALIZATION PHOTOGRAPHS



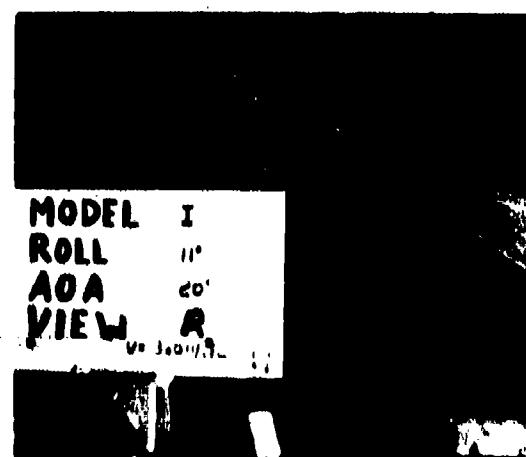
1a. PICTURE A- LEFT SIDE VIEW



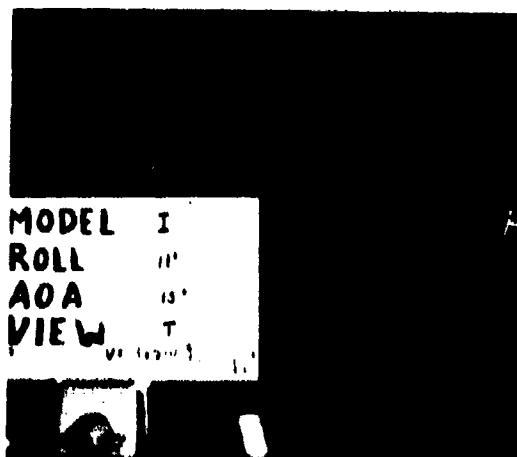
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW

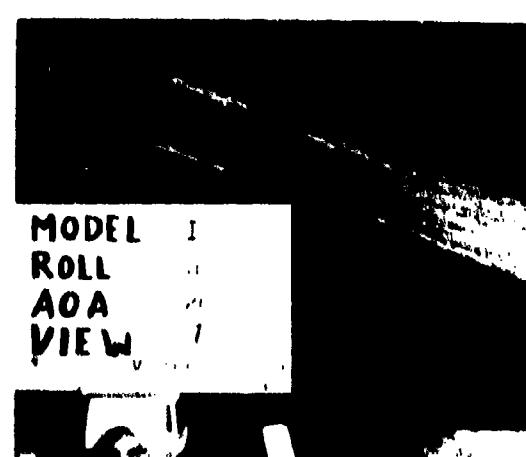


2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

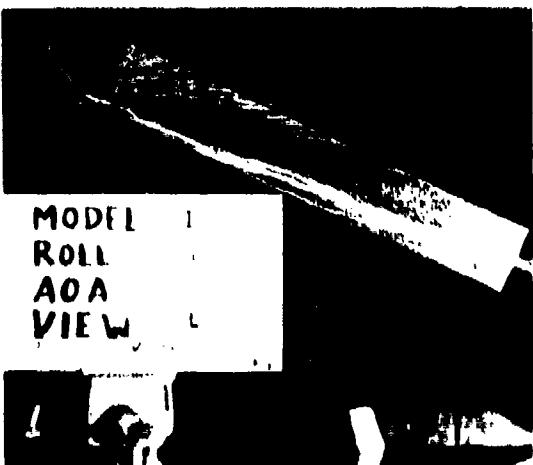
COLUMN 1. MISSILE I, 11° ROLL, 15° AOA



2c. PICTURE F- TOPSIDE VIEW

COLUMN 2. MISSILE I, 11° ROLL, 20° AOA

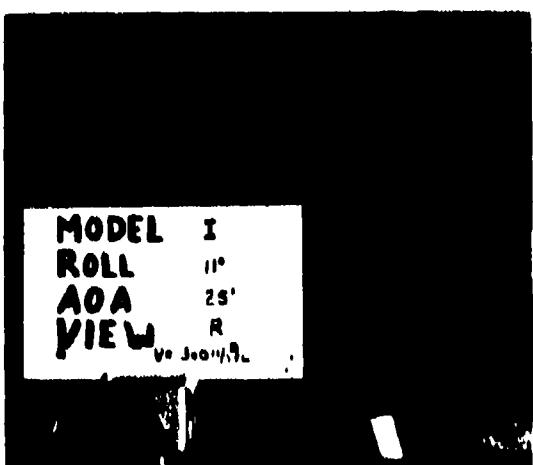
FIGURE E-3. OIL FLOW VISUALIZATION PHOTOGRAPHS



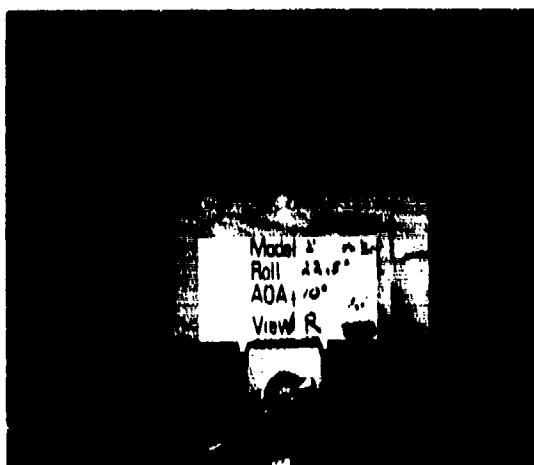
1a. PICTURE A- LEFT SIDE VIEW



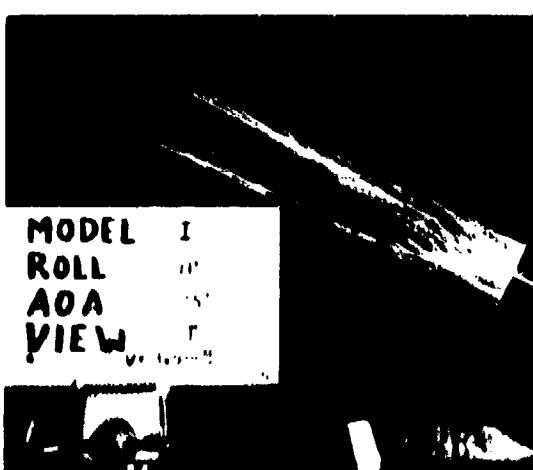
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

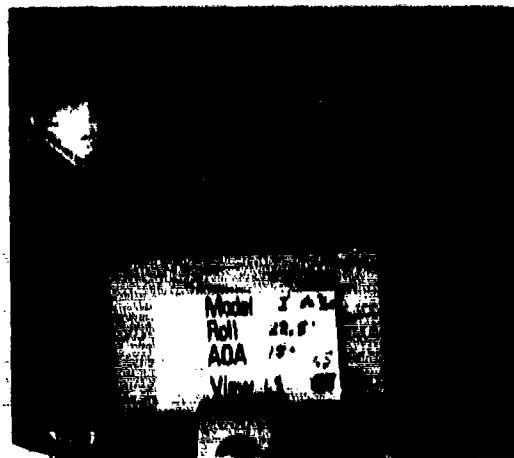
COLLAR 1, MODEL I, 11° ROLL, 25° AOA



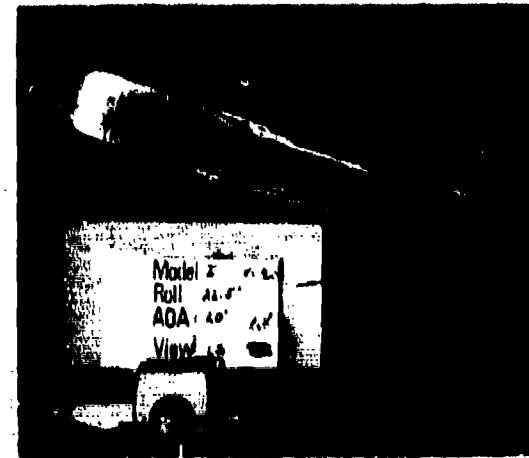
2c. PICTURE F- TOPSIDE VIEW

COLLAR 1, MODEL I, 11° ROLL, 25° AOA

FIGURE E-4. OIL FLOW VISUALIZATION PHOTOGRAPHS



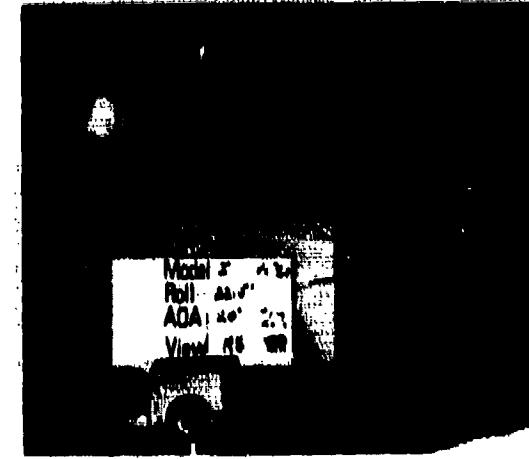
1a. PICTURE A- LEFT SIDE VIEW



2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW

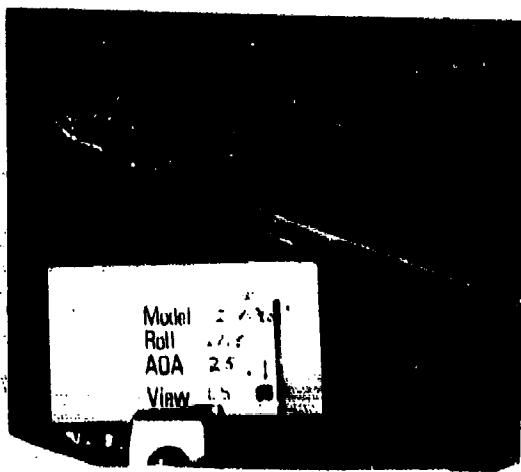


2b. PICTURE E- RIGHT SIDE VIEW

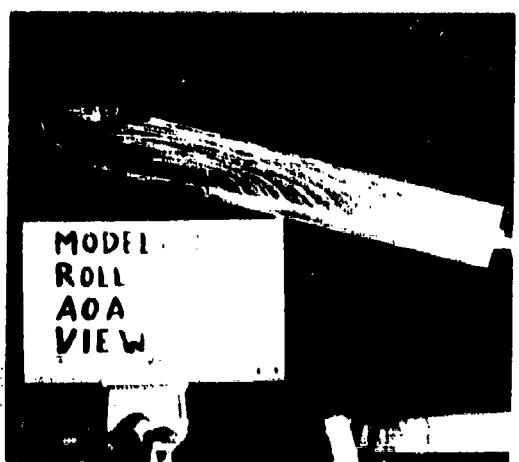
COLUMN 1. MISSILE 1, 22° ROLL, 19° AOA

COLUMN 2. MISSILE 1, 22° ROLL, 20° AOA

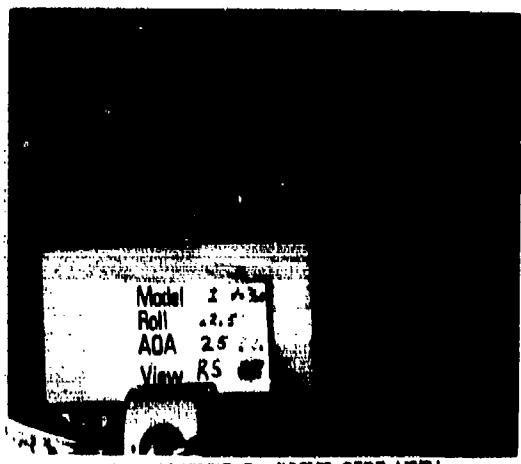
FIGURE E-5. OIL FLOW VISUALIZATION PHOTOGRAPHS



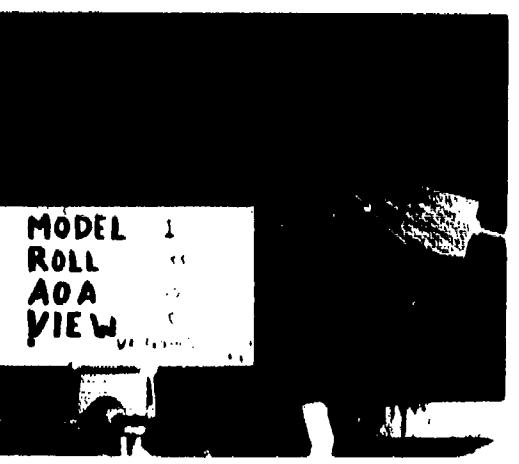
1a. PICTURE A- LEFT SIDE VIEW



2a. PICTURE D- LEFT SIDE VIEW



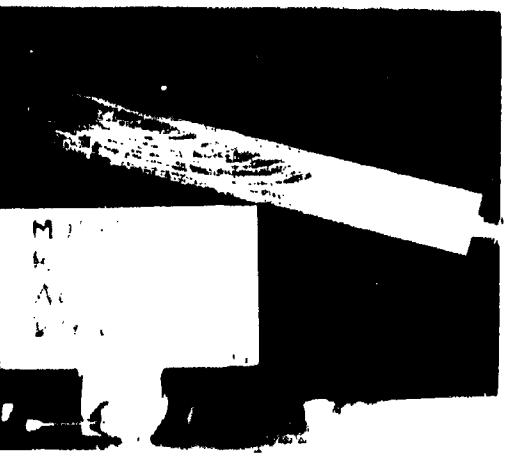
1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

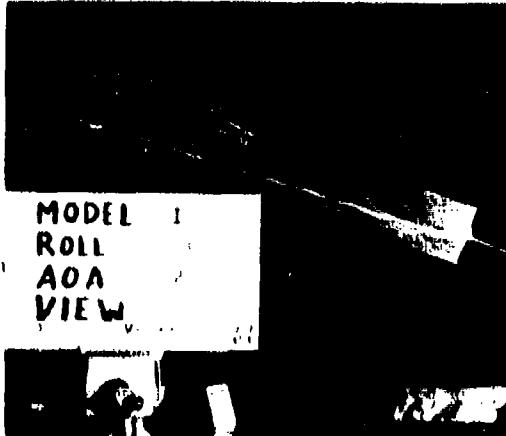


2c. PICTURE F- TOPSIDE VIEW

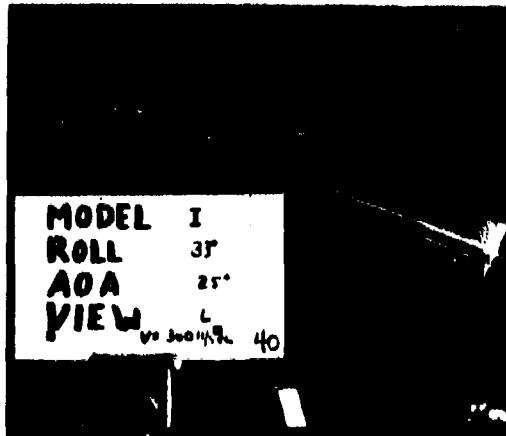
COLUMN 1. MISSILE 1, 22° ROLL, 2.5° AOA

COLUMN 2. MISSILE 1, 33° ROLL, 15° AOA

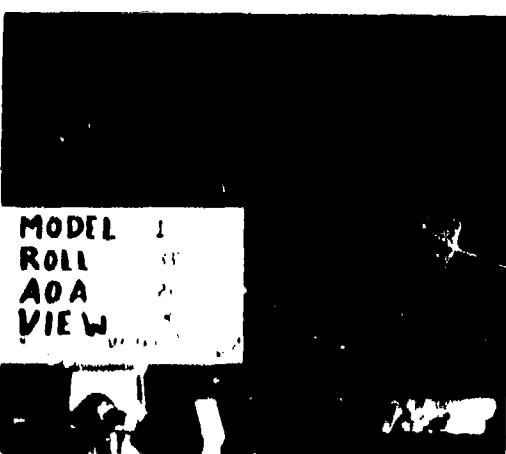
FIGURE E-6. OIL FLOW VISUALIZATION PHOTOGRAPHS



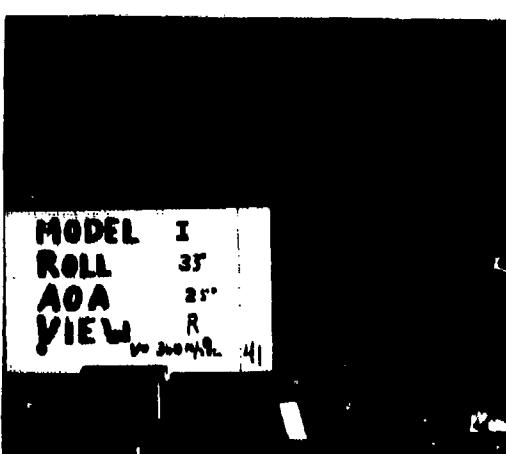
1a. PICTURE A- LEFT SIDE VIEW



2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW

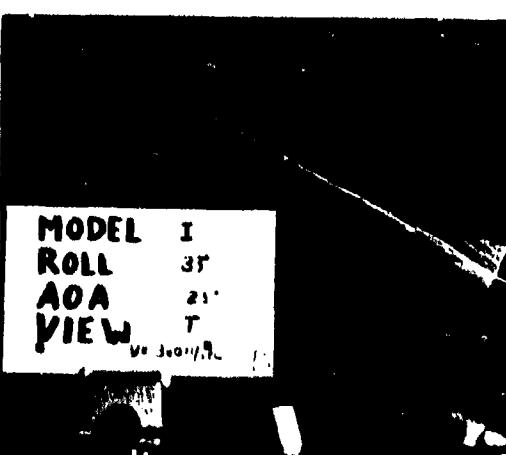


2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

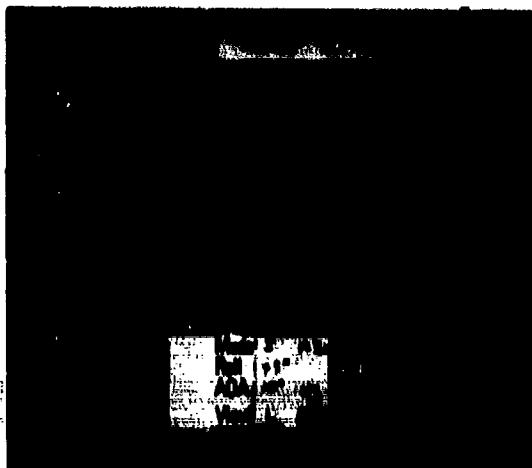
COLUMN 1. MISSILE I, 35° ROLL, 25° AOA



2c. PICTURE F- TOPSIDE VIEW

COLUMN 2. MISSILE I, 35° ROLL, 25° AOA

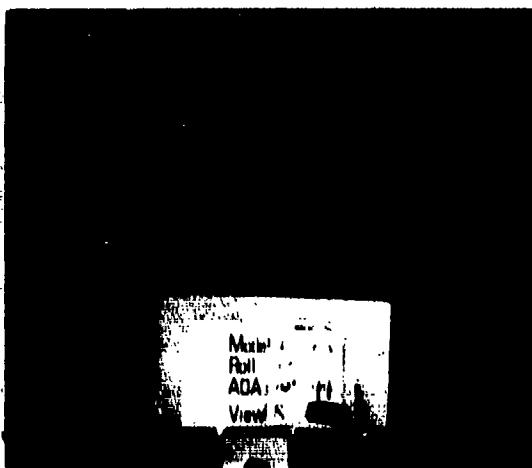
FIGURE E-7 OIL FLOW VISUALIZATION PHOTOGRAPHS



1a. PICTURE A- LEFT SIDE VIEW



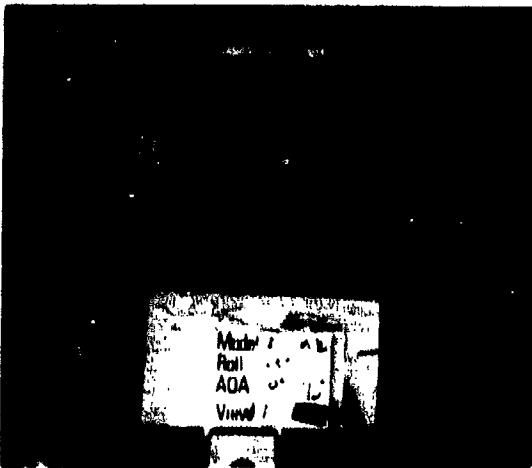
2a. PICTURE D- LEFT SIDE VIEW



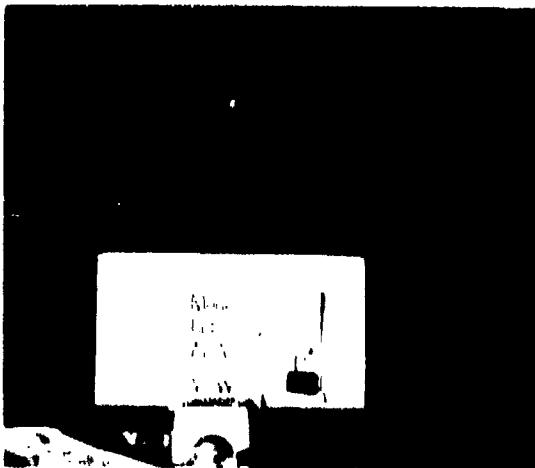
1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW



2c. PICTURE F- TOPSIDE VIEW

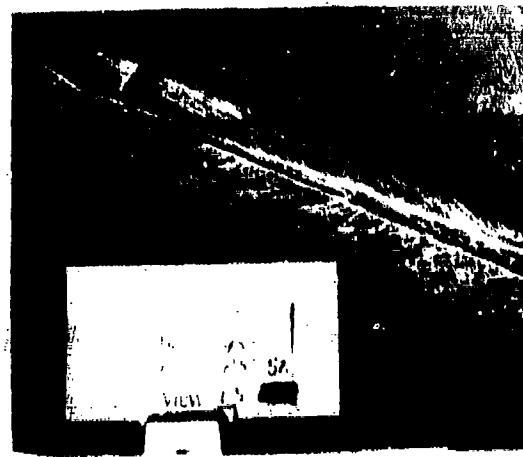
COLUMN 1. MISSILE 1, 45° ROLL, 10° AOA

COLUMN 2. MISSILE 1, 45° ROLL, 15° AOA

FIGURE E-8. OIL FLOW VISUALIZATION PHOTOGRAPHS



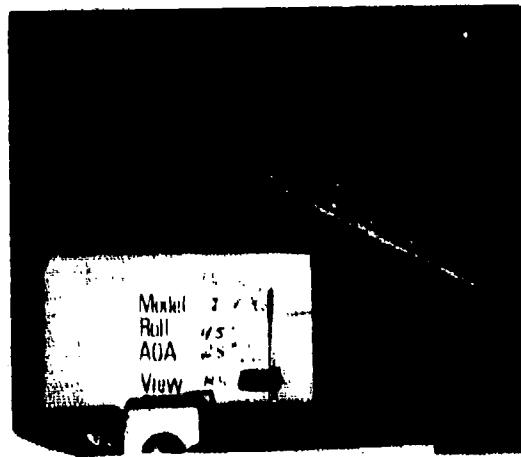
1a. PICTURE A- LEFT SIDE VIEW



2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW

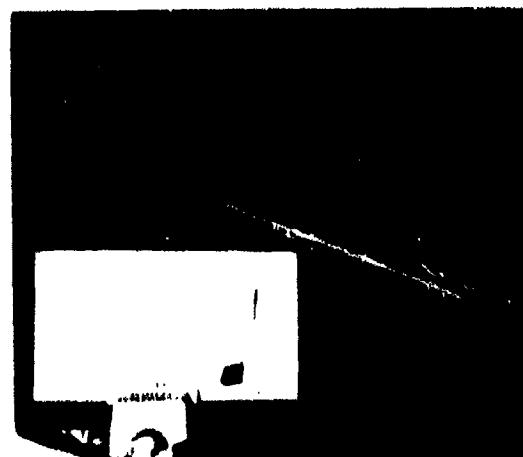


2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

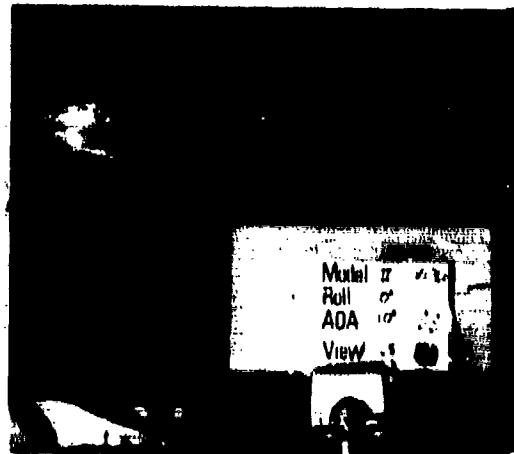
COLUMN 1. MISSILE 1, 45° ROLL, 45° AOA



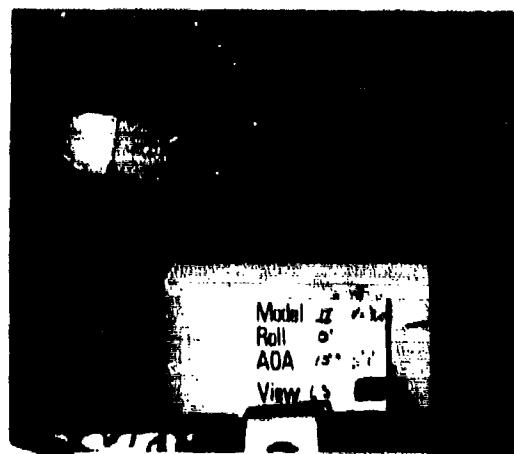
2c. PICTURE F- TOPSIDE VIEW

COLUMN 2. MISSILE 1, 45° ROLL, 45° AOA

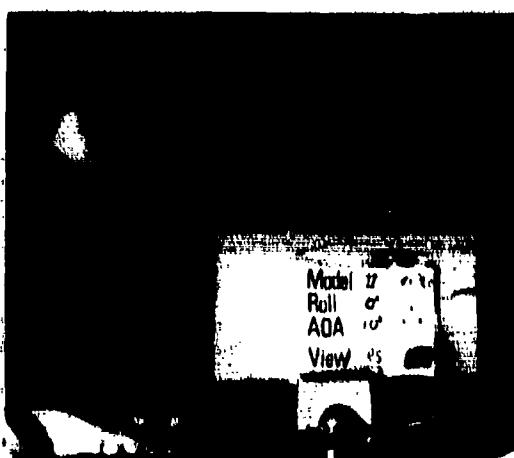
FIGURE E-9 OIL FLOW VISUALIZATION PHOTOGRAPHS



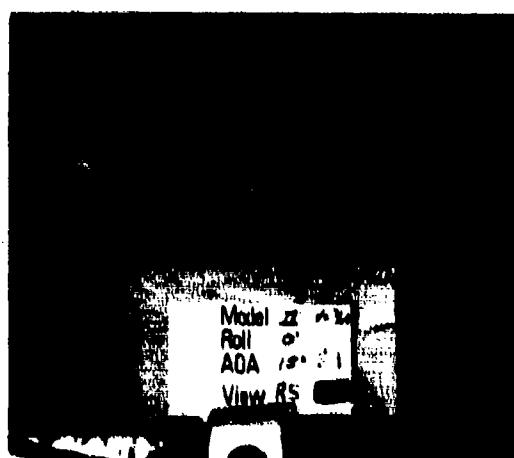
1a. PICTURE A- LEFT SIDE VIEW



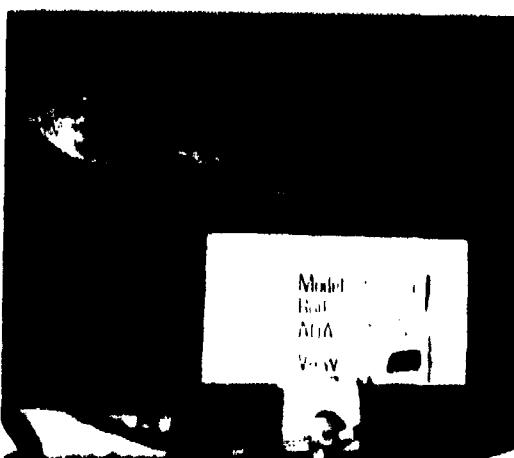
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW

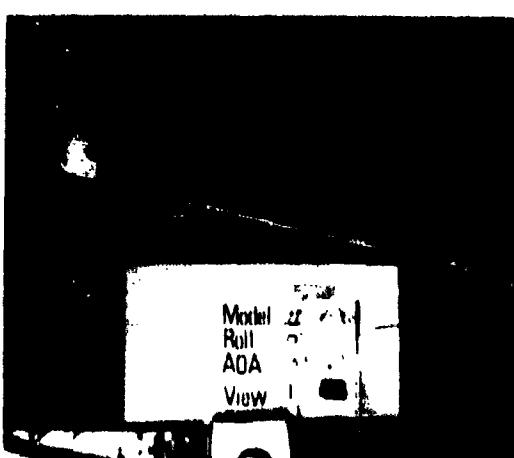


2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

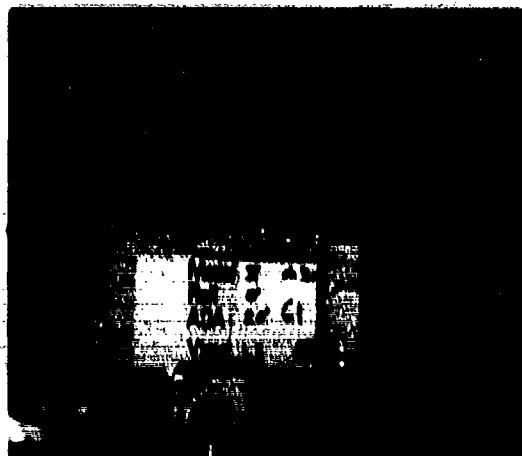
COLUMN 1. MISSILE 11, 0° ROLL, 10° AOA



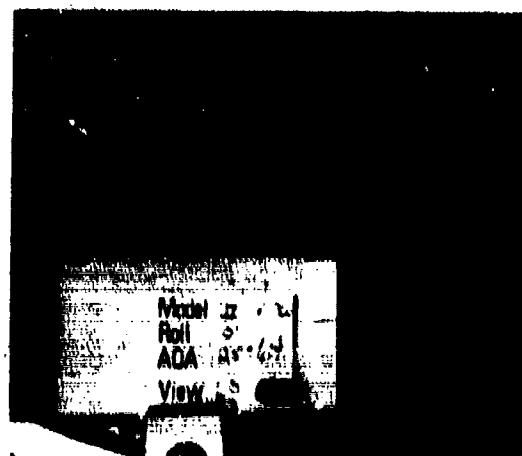
2c. PICTURE F- TOPSIDE VIEW

COLUMN 2. MISSILE 11, 0° ROLL, 15° AOA

FIGURE E-10. OIL FLOW VISUALIZATION PHOTOGRAPHS



1a. PICTURE A- LEFT SIDE VIEW



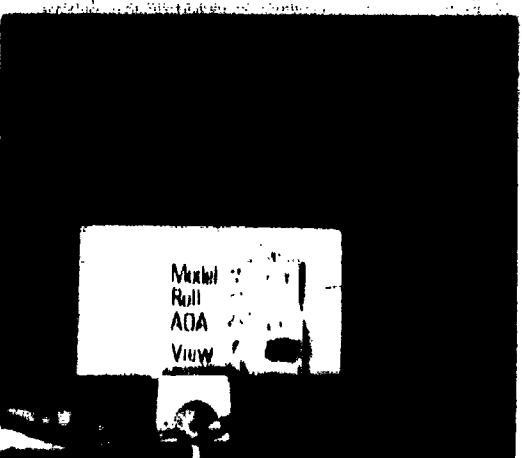
2a. PICTURE D- LEFT SIDE VIEW



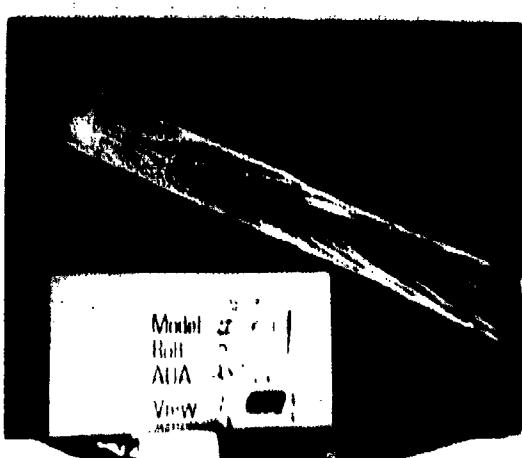
1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

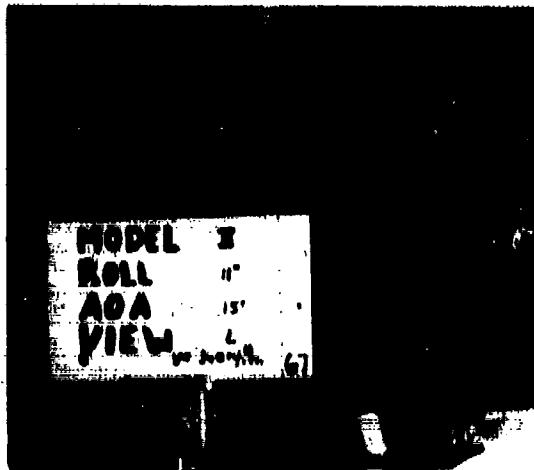


2c. PICTURE F- TOPSIDE VIEW

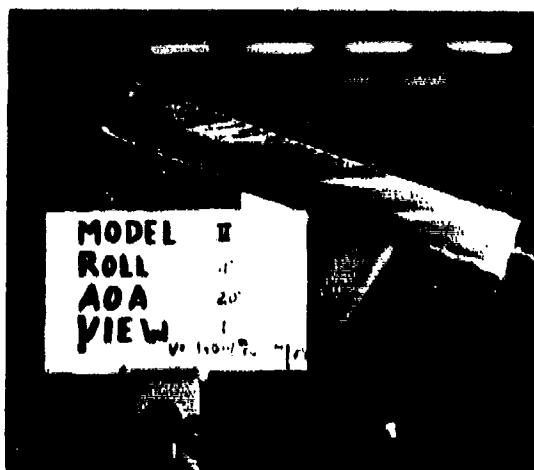
COLUMN 1. MISSILE II, 0° ROLL, 20° AIA

COLUMN 2. MISSILE II, 0° ROLL, 25° AIA

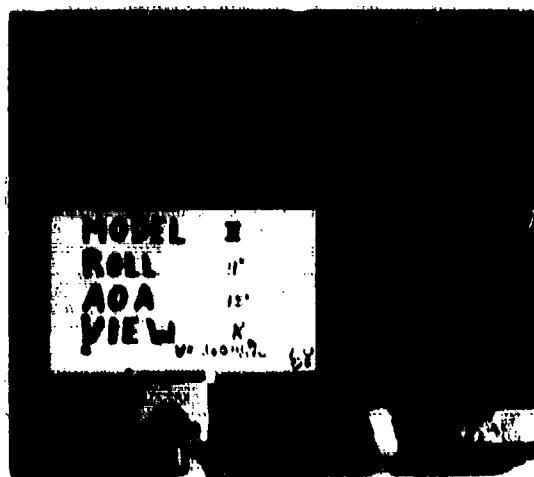
FIGURE E-11. OIL FLOW VISUALIZATION PHOTOGRAPHS



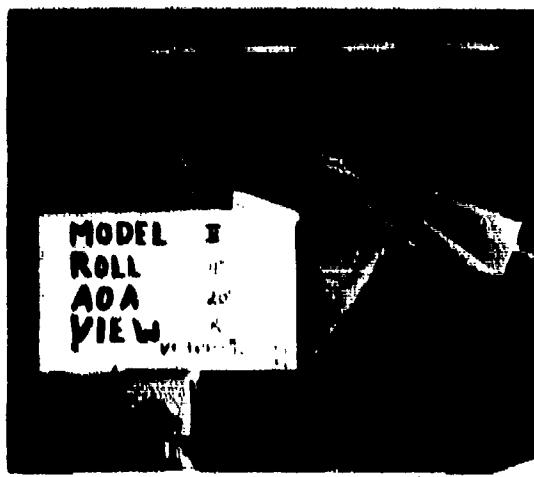
1a. PICTURE A- LEFT SIDE VIEW



2a. PICTURE D- LEFT SIDE VIEW



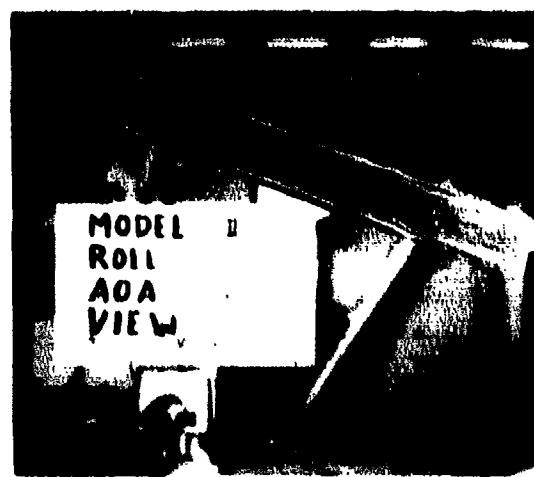
1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

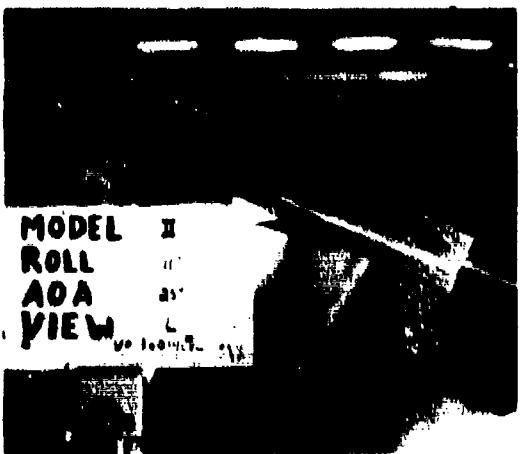


2c. PICTURE F- TOPSIDE VIEW

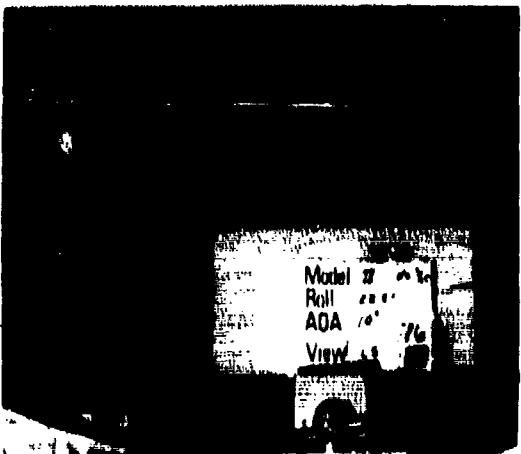
COLUMN 1. MISSILE II, 11° ROLL, 15° AOA

COLUMN 2. MISSILE II, 11° ROLL, 20° AOA

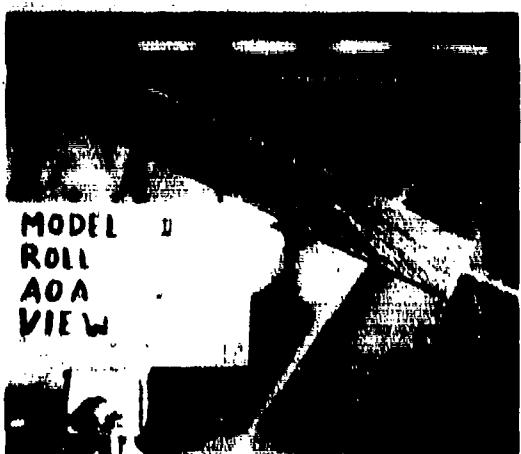
FIGURE E-12. OIL FLOW VISUALIZATION PHOTOGRAPHS



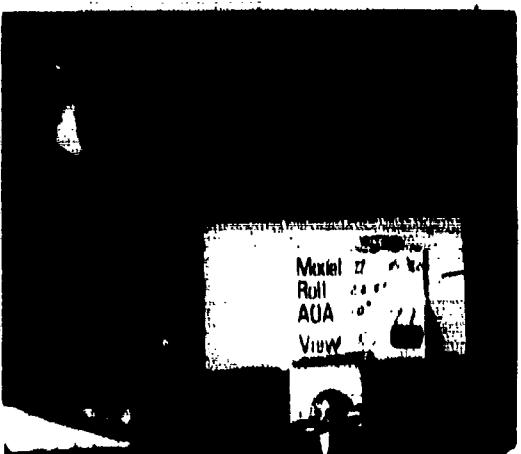
1a. PICTURE A- LEFT SIDE VIEW



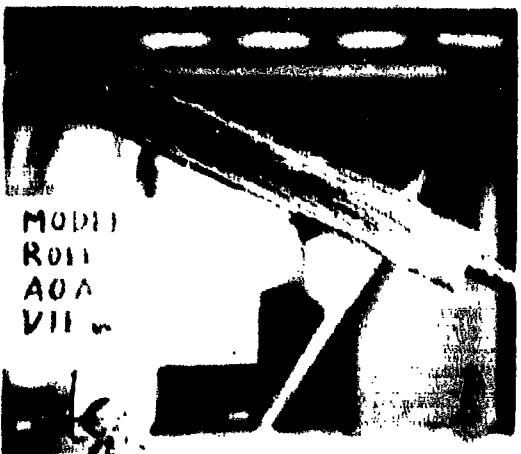
2a. PICTURE D- LEFT SIDE VIEW



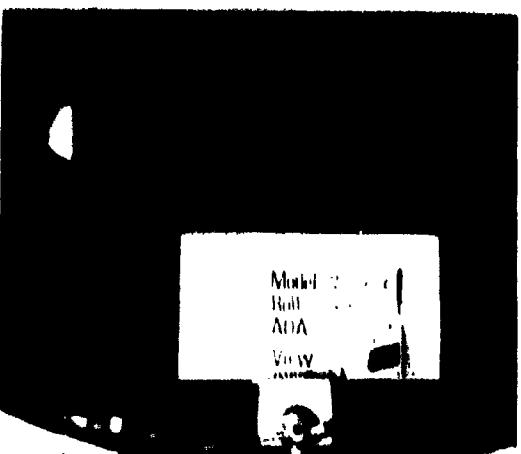
1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

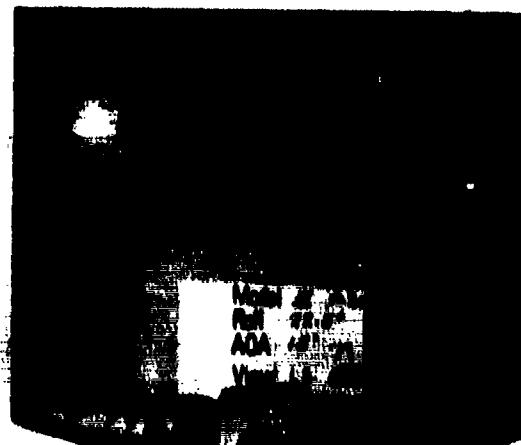


2c. PICTURE F- TOPSIDE VIEW

COLUMN 1. MISSILE II, 10° ROLL, 25° AOA

COLUMN 2. MISSILE II, 22° ROLL, 10° AOA

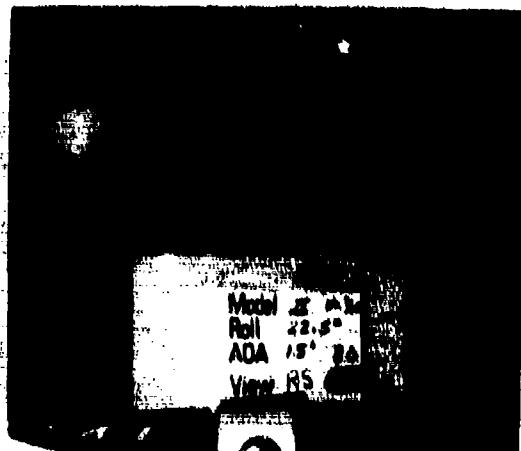
FIGURE E-13 OIL FLOW VISUALIZATION PHOTOGRAPHS



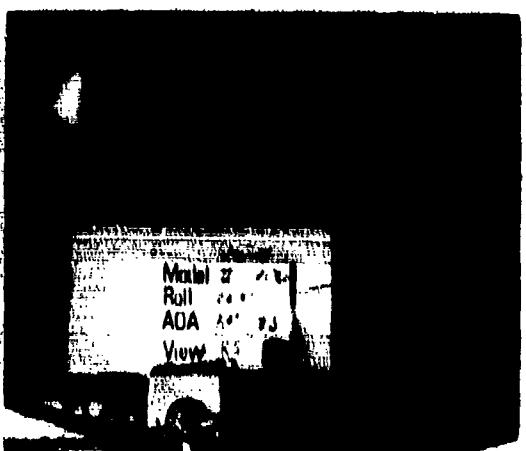
1a. PICTURE A- LEFT SIDE VIEW



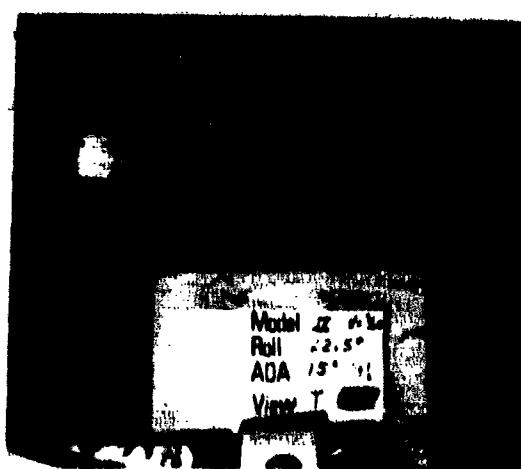
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

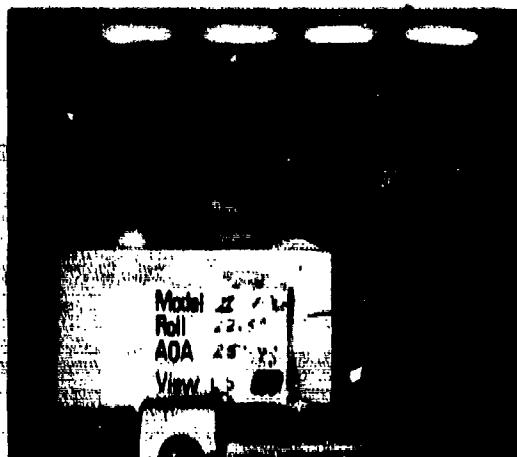


2c. PICTURE F- TOPSIDE VIEW

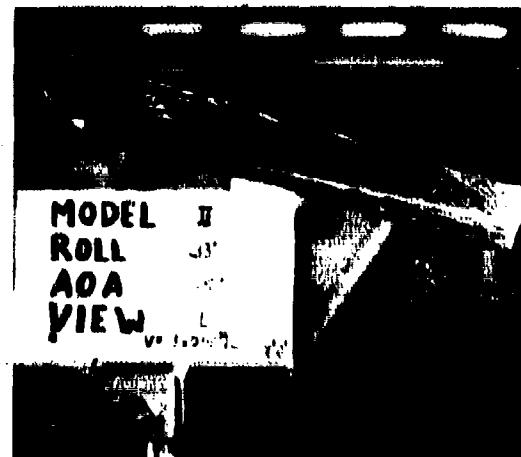
COLUMN 1. MISSILE 11, 22° ROLL, 15° AOA

COLUMN 2. MISSILE 11, 22° ROLL, 20° AOA

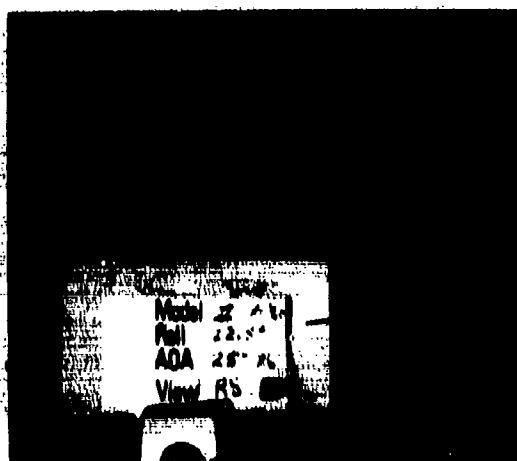
FIGURE E-14. OIL FLOW VISUALIZATION PHOTOGRAPHS



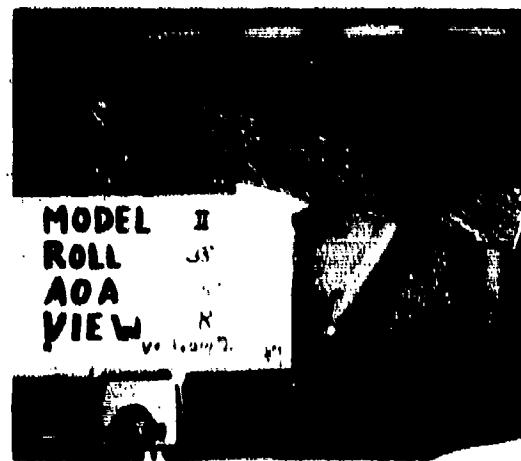
1a. PICTURE A- LEFT SIDE VIEW



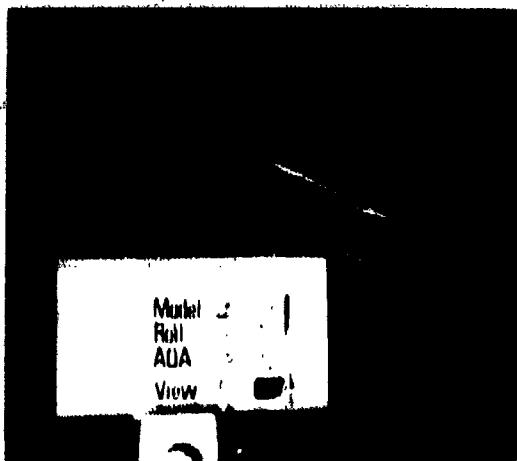
2a. PICTURE D- LEFT SIDE VIEW



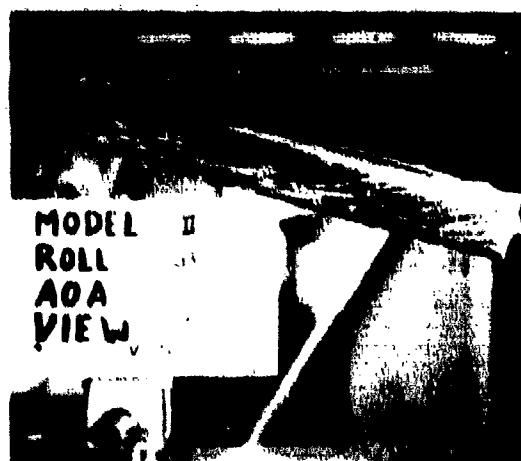
1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

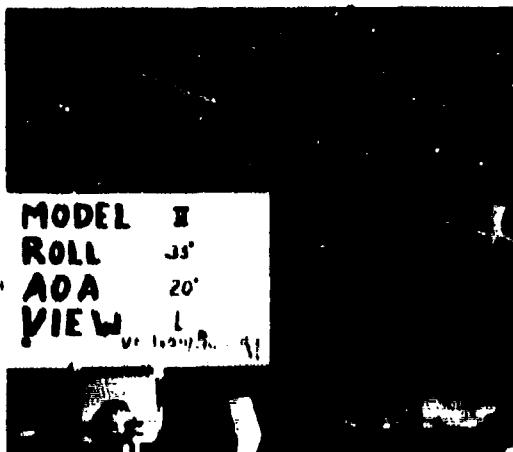


2c. PICTURE F- TOPSIDE VIEW

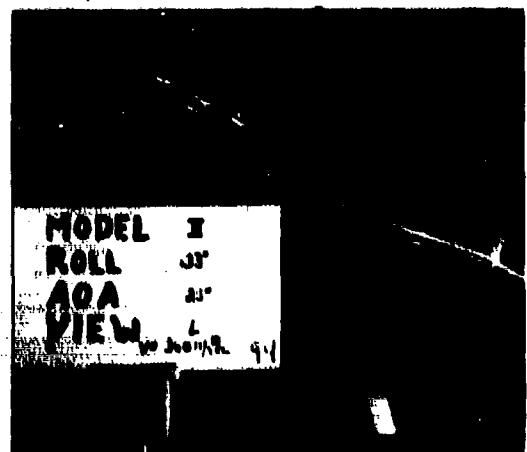
COLUMN 1. MISSILE II, 22° ROLL, 25° AOA

COLUMN 2. MISSILE II, 45° ROLL, 25° AOA

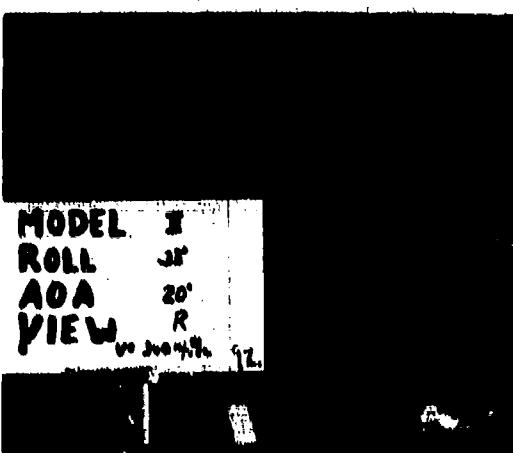
FIGURE E-15. OIL FLOW VISUALIZATION PHOTOGRAPHS



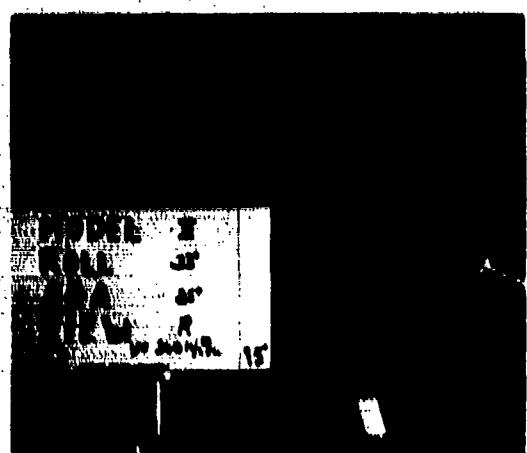
1a. PICTURE A- LEFT SIDE VIEW



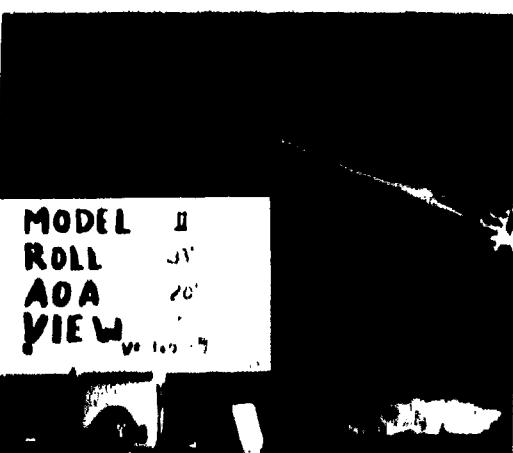
2a. PICTURE D- LEFT SIDE VIEW



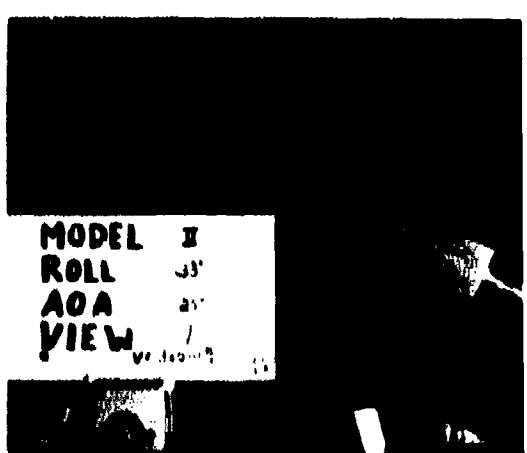
1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

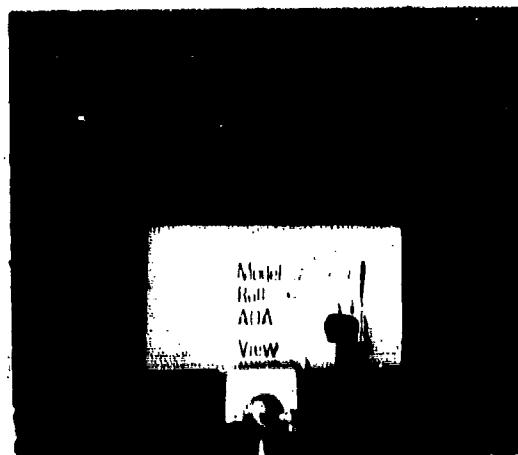


2c. PICTURE F- TOPSIDE VIEW

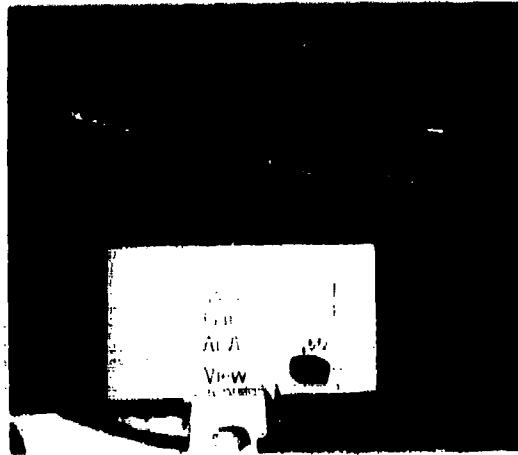
COLUMN 1. MISSILE II, 35° ROLL, 20° AOA

COLUMN 2. MISSILE II, 35° ROLL, 20° AOA

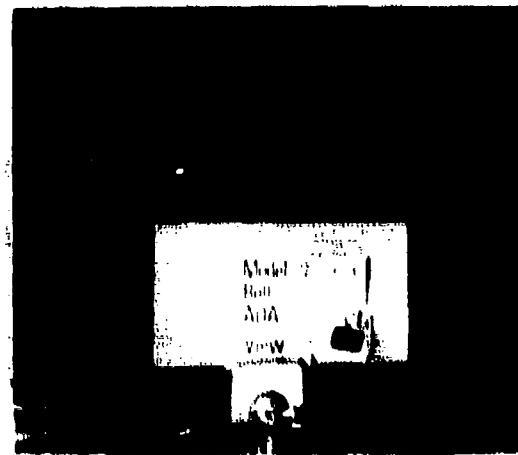
FIGURE E-16. OIL FLOW VISUALIZATION PHOTOGRAPHS



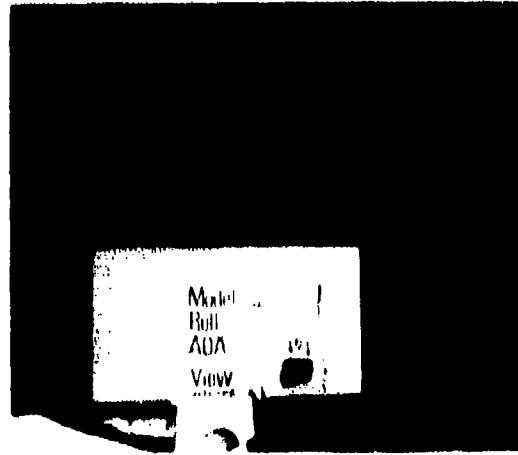
1a. PICTURE A- LEFT SIDE VIEW



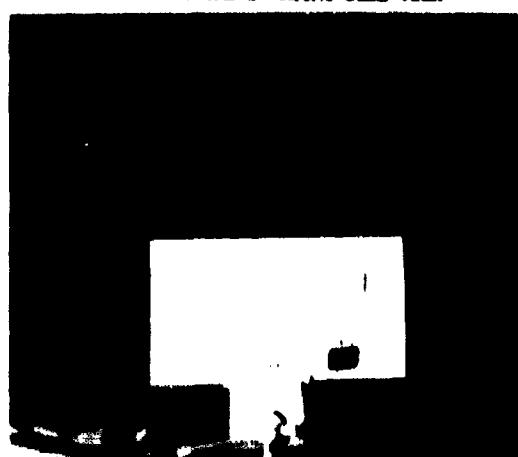
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

COLUMN 1. MISSILE 17, 10° ROLL, 10° AOA



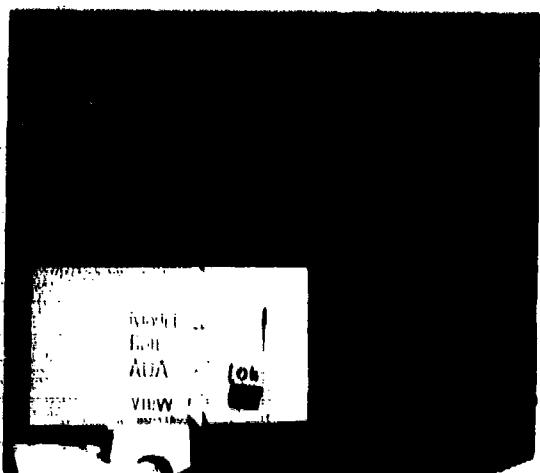
2c. PICTURE F- TOPSIDE VIEW

COLUMN 2. MISSILE 17, 45° ROLL, 15° AOA

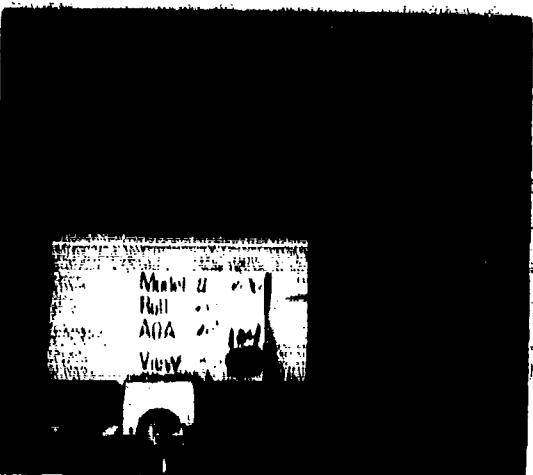
FIGURE E-17. OIL FLOW VISUALIZATION PHOTOGRAPHS



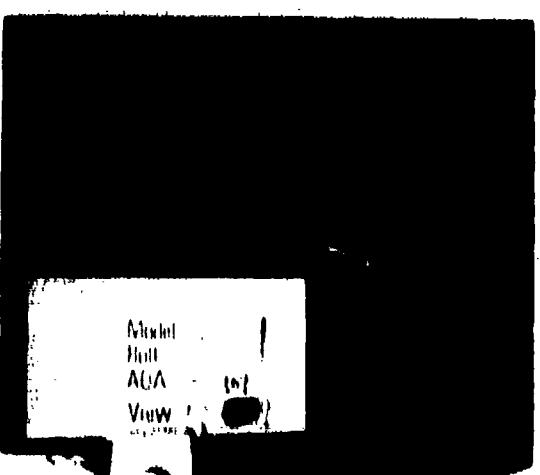
1a. PICTURE A- LEFT SIDE VIEW



2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

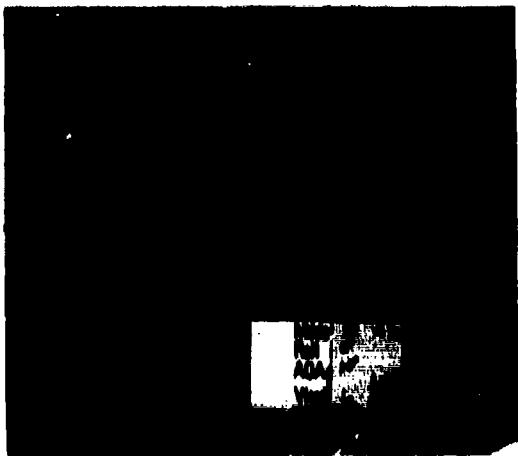


2c. PICTURE F- TOPSIDE VIEW

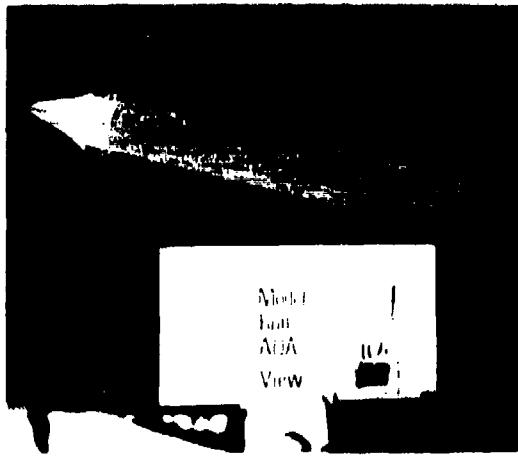
COLUMN 1. MISSILE 11, 45° ROLL, 20° AOA

COLUMN 2. MISSILE 11, 45° ROLL, 25° AOA

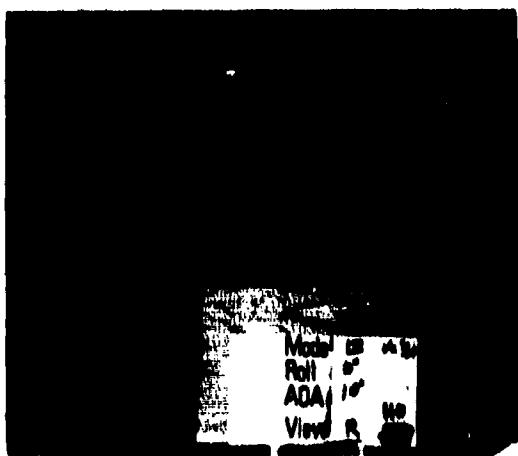
FIGURE E-18 OIL FLOW VISUALIZATION PHOTOGRAPHS



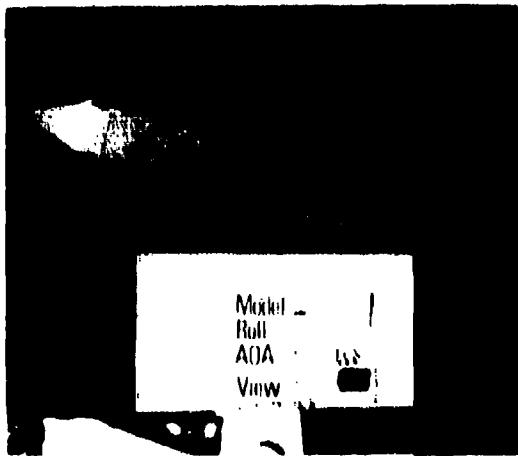
1a. PICTURE A- LEFT SIDE VIEW



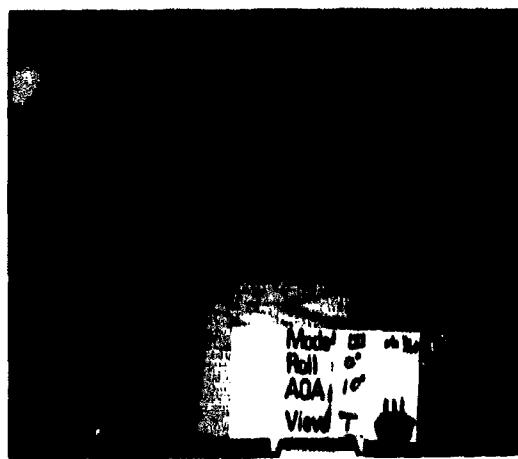
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

COLUMN 1. MISSILE 10, 0° ROLL, 10° AOA



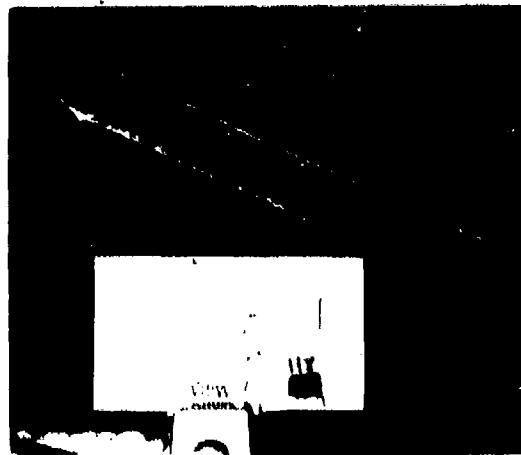
2c. PICTURE F- TOPSIDE VIEW

COLUMN 2. MISSILE 10, 0° ROLL, 15° AOA

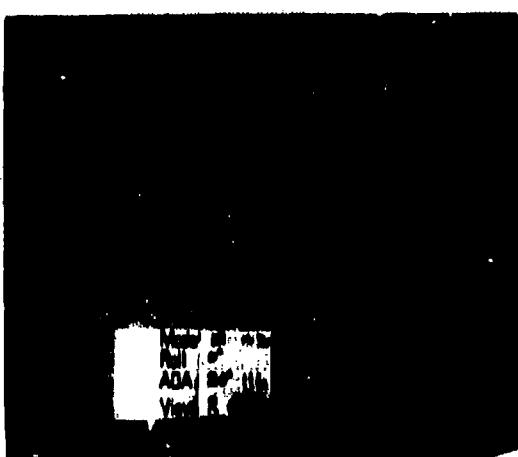
FIGURE E-19. OIL FLOW VISUALIZATION PHOTOGRAPHS



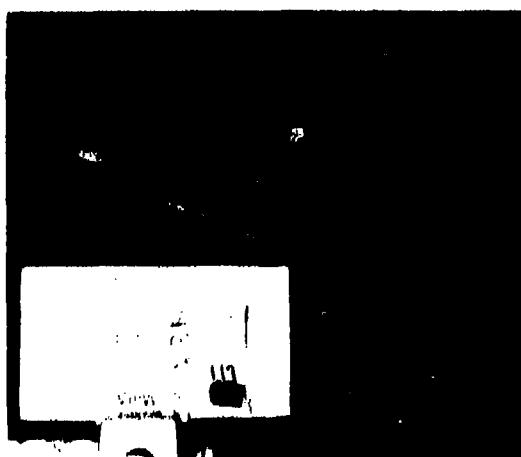
1a. PICTURE A- LEFT SIDE VIEW



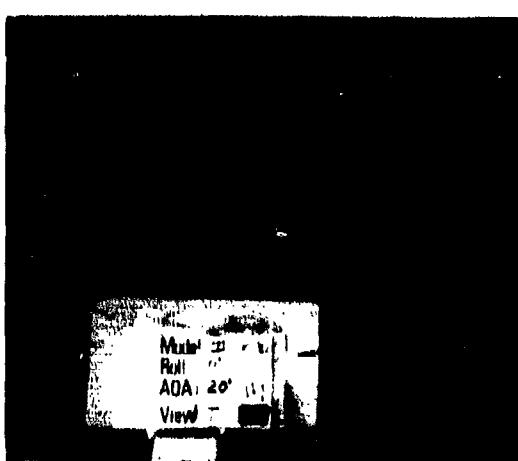
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

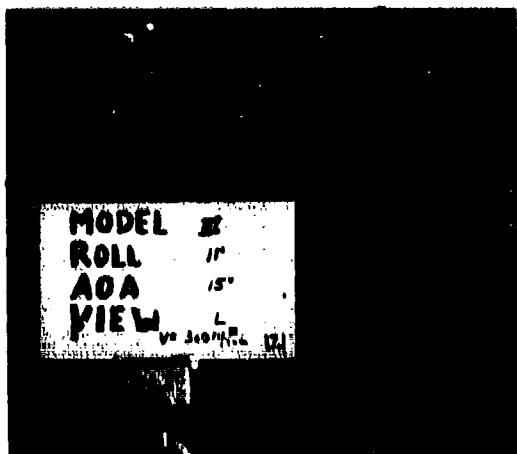


2c. PICTURE F- TOPSIDE VIEW

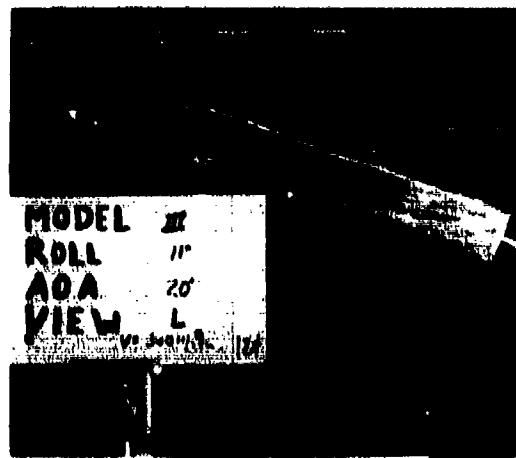
COLUMN 1. MISSILE 111, 0° ROLL, 20° AOA

COLUMN 2. MISSILE 111, 0° ROLL, 25° AOA

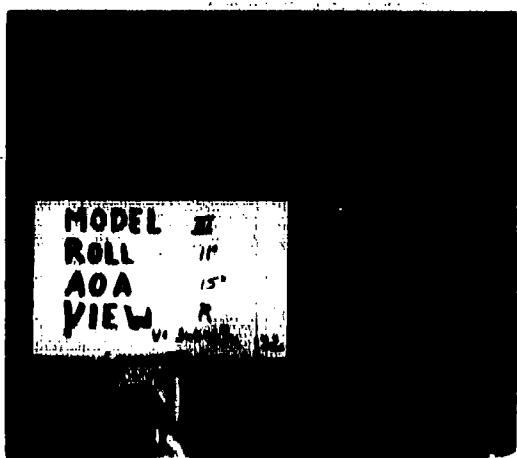
FIGURE E-20 OIL FLOW VISUALIZATION PHOTOGRAPHS



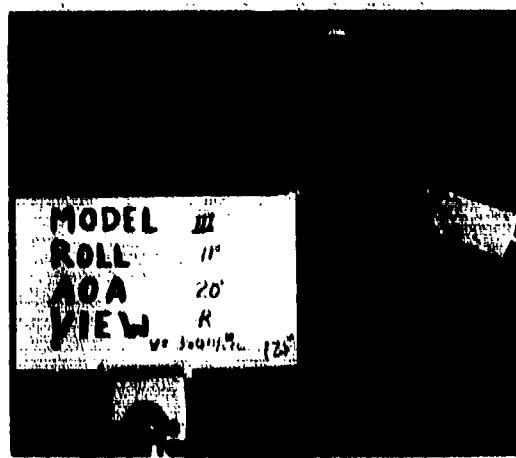
1a. PICTURE A- LEFT SIDE VIEW



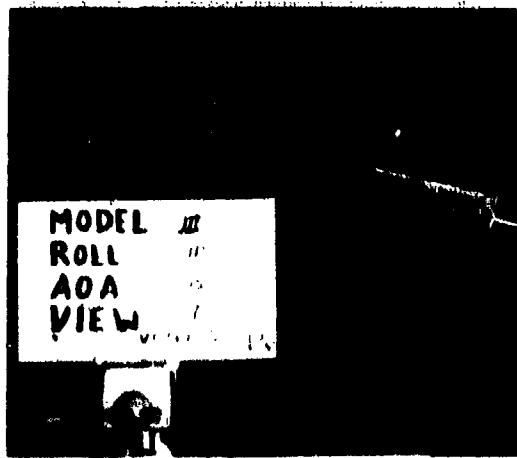
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW

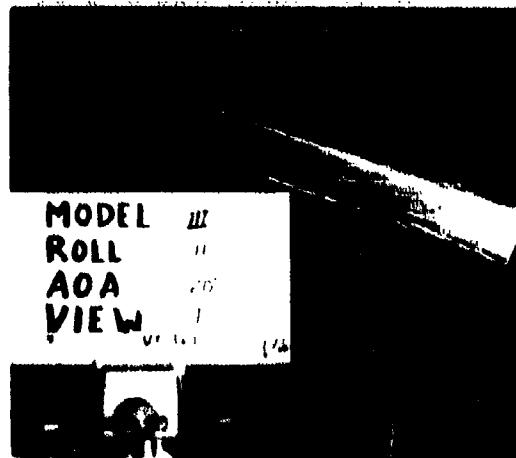


2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

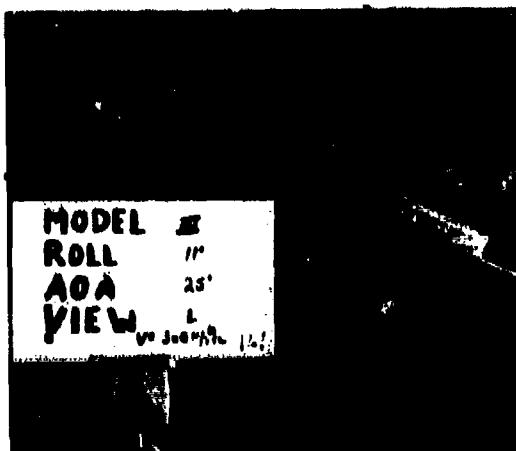
COLUMN 1. MISSILE III, 11° ROLL, 15° AOA



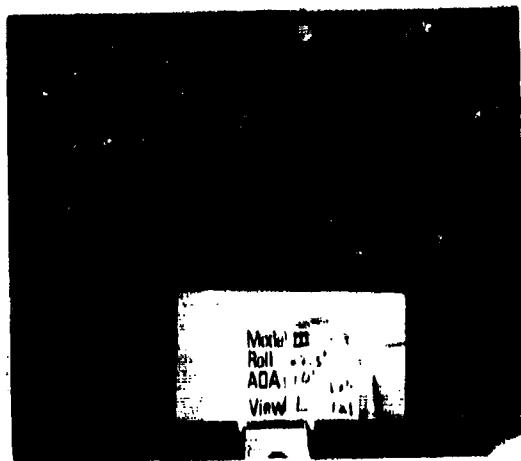
2c. PICTURE F- TOPSIDE VIEW

COLUMN 2. MISSILE III, 11° ROLL, 20° AOA

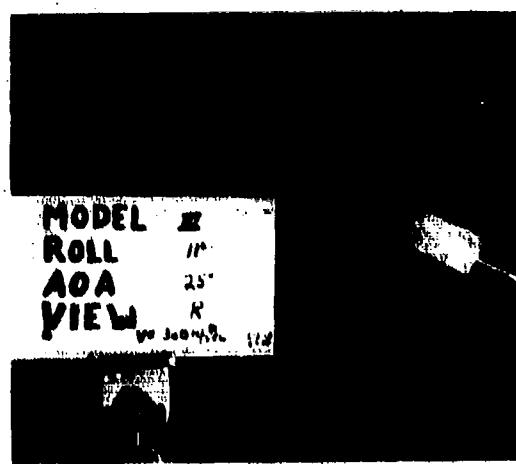
FIGURE E-21 OIL FLOW VISUALIZATION PHOTOGRAPHS



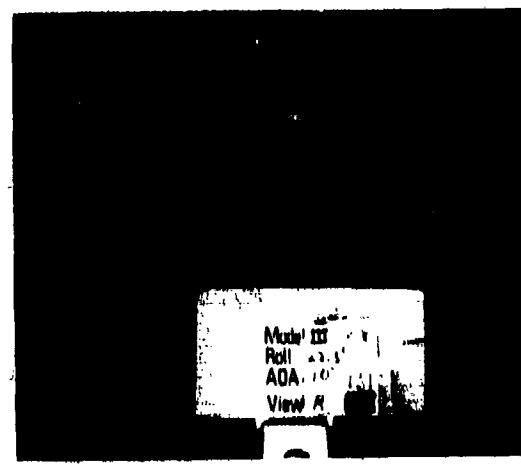
1a. PICTURE A- LEFT SIDE VIEW



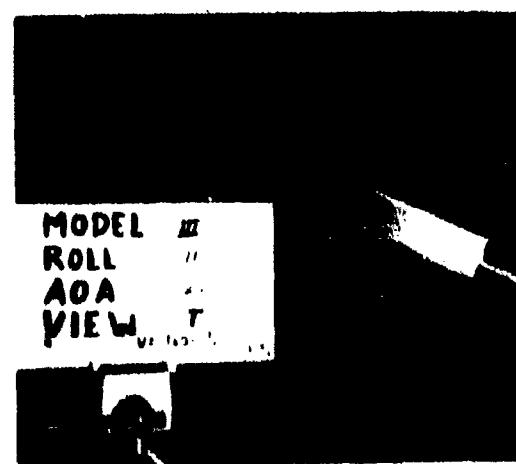
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW

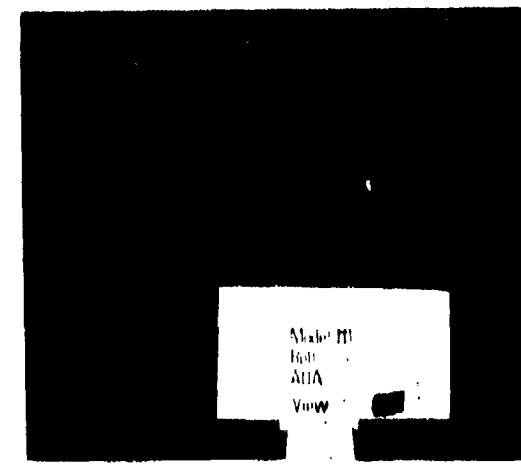


2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

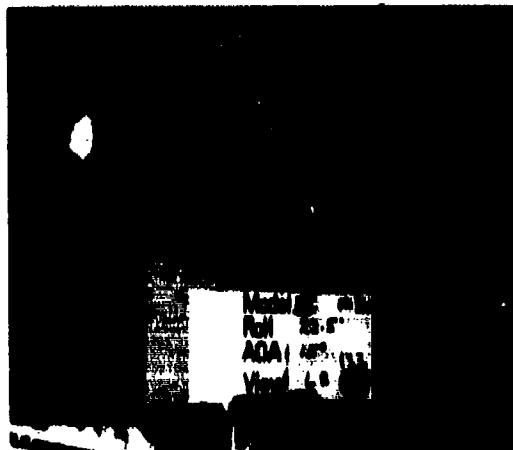
COLUMN 1. MISSILE III, 11° ROLL, 25° AOA



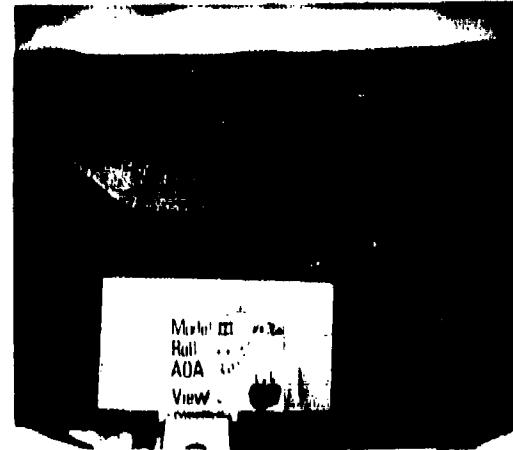
2c. PICTURE F- TOPSIDE VIEW

COLUMN 2. MISSILE III, 11° ROLL, 10° AOA

FIGURE E-22. OIL FLOW VISUALIZATION PHOTOGRAPHS



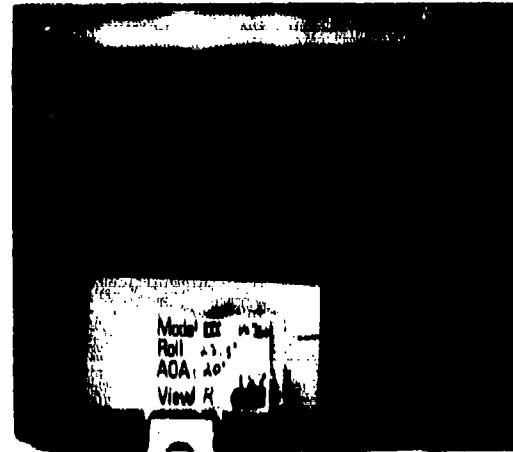
1a. PICTURE A- LEFT SIDE VIEW



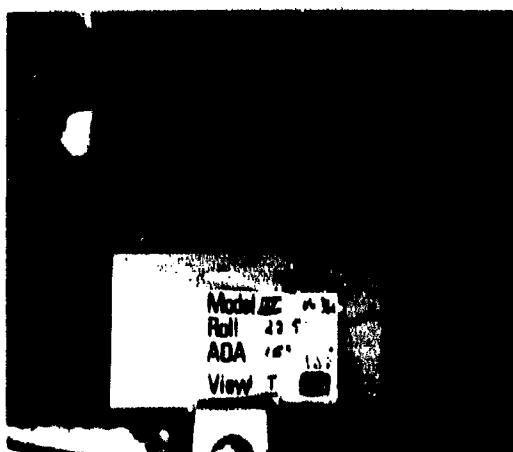
2a. PICTURE D- LEFT SIDE VIEW



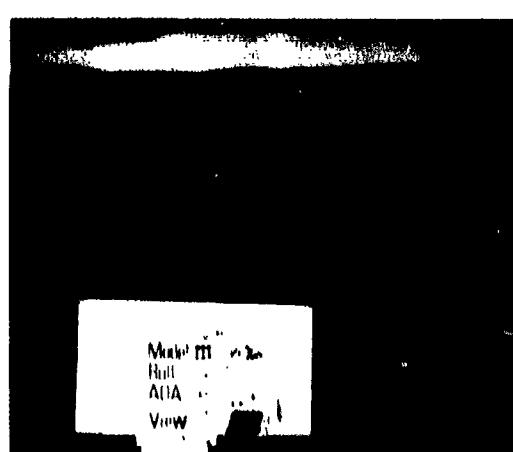
1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

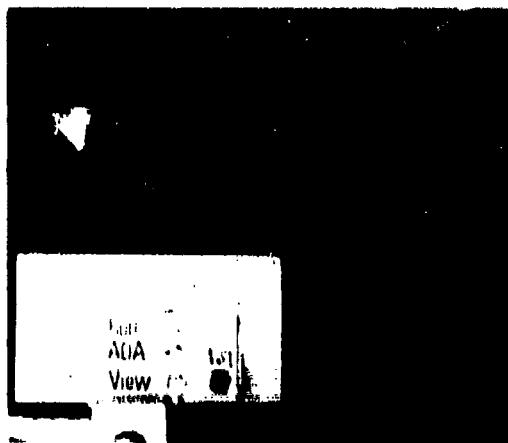


2c. PICTURE F- TOPSIDE VIEW

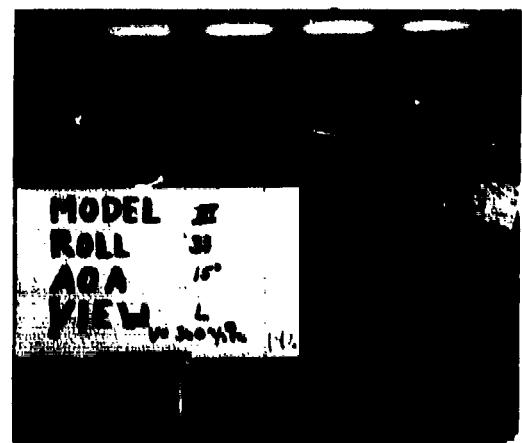
COLUMN 1: MERCURY TELLURETTE, 23.5° ROLL, 15° AOA

COLUMN 2: MERCURY TELLURETTE, 23.5° ROLL, 15° AOA

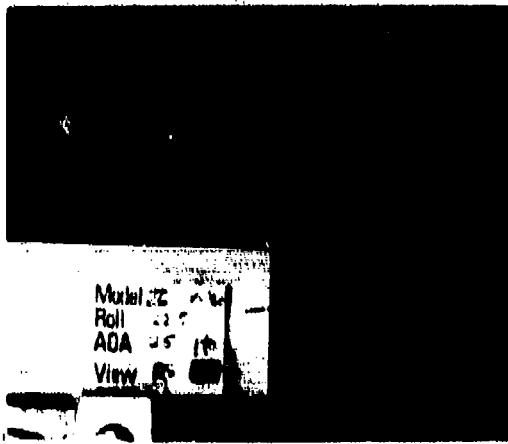
FIGURE E-23. OIL FLOW VISUALIZATION PHOTOGRAPHS



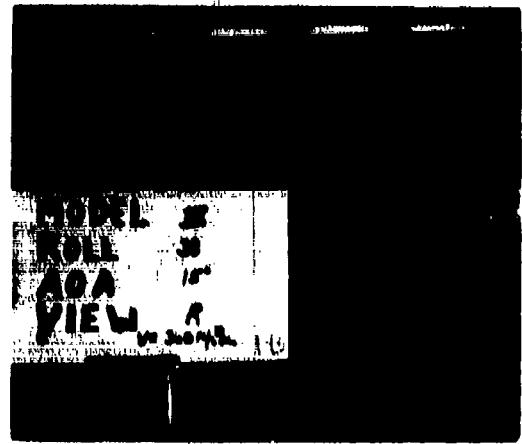
1a. PICTURE A- LEFT SIDE VIEW



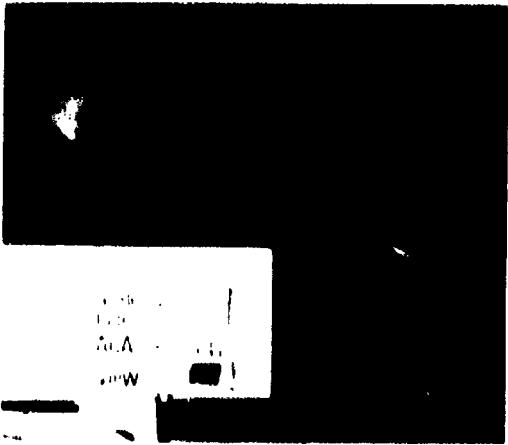
2a. PICTURE D- LEFT SIDE VIEW



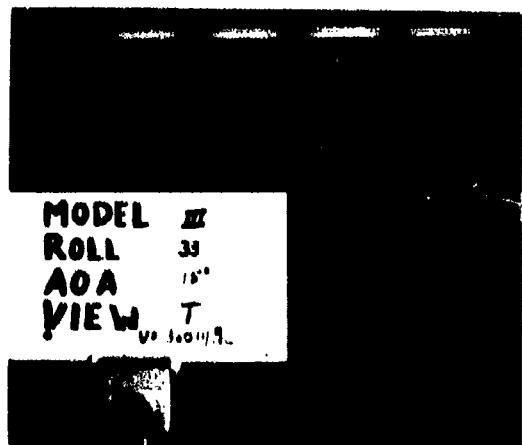
1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

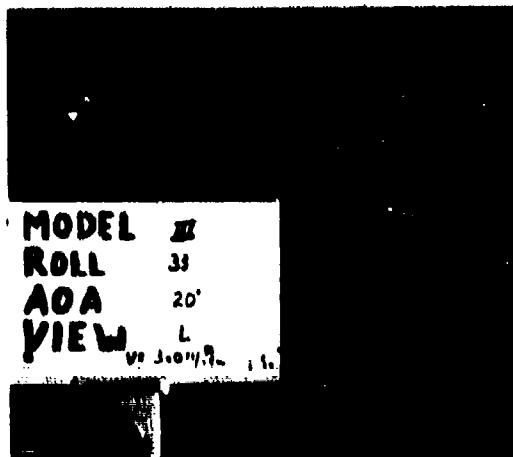


2c. PICTURE F- TOPSIDE VIEW

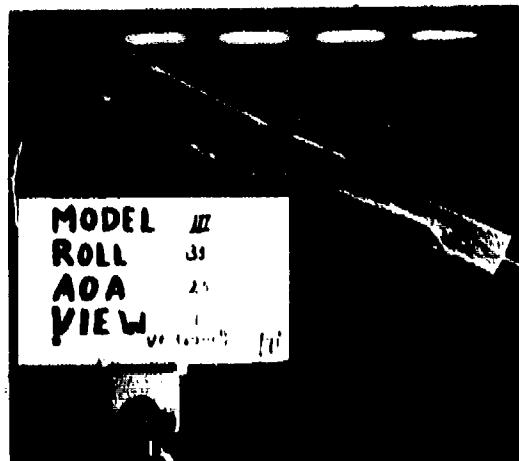
COLUMN 1. MUSCLE TEE, 20° ROLL, 20° AOA

COLUMN 2. MUSCLE TEE, 30° ROLL, 20° AOA

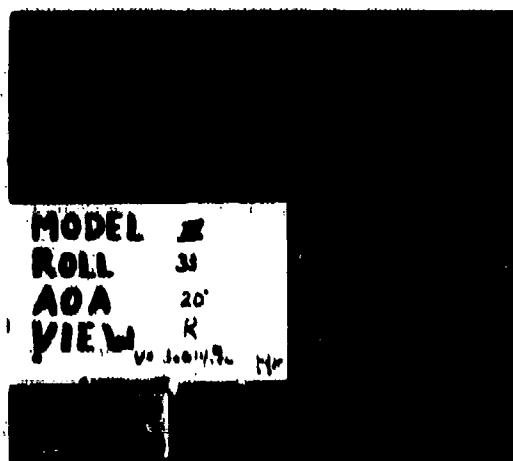
FIGURE E-24 DIL FLOW VISUALIZATION PHOTOGRAPHS



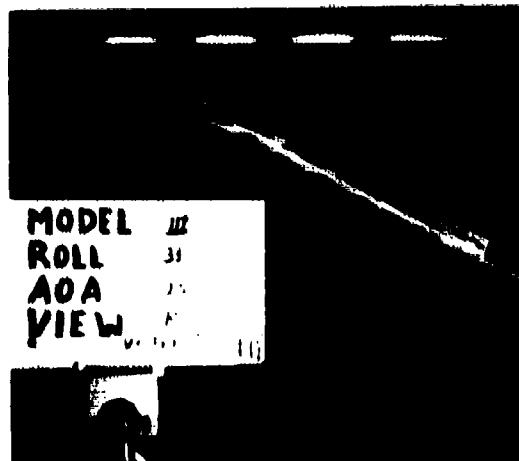
1a. PICTURE A- LEFT SIDE VIEW



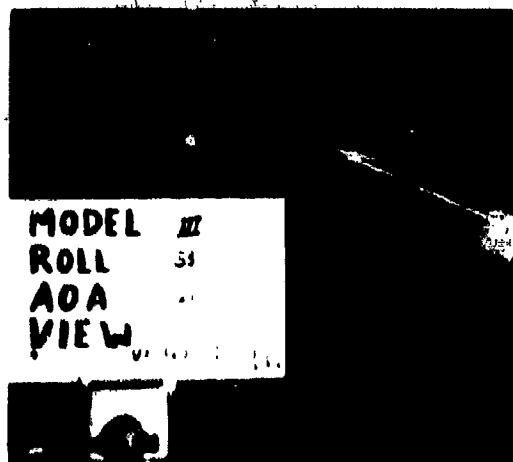
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW

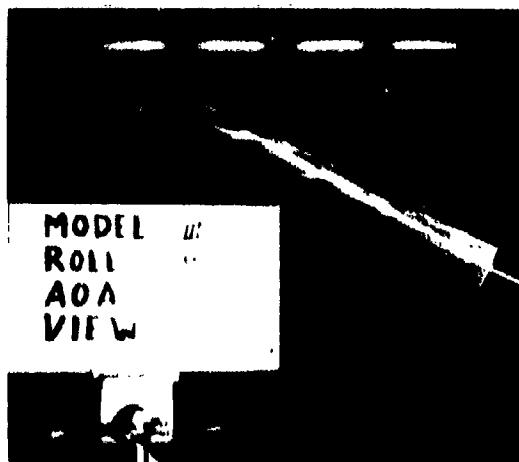


2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

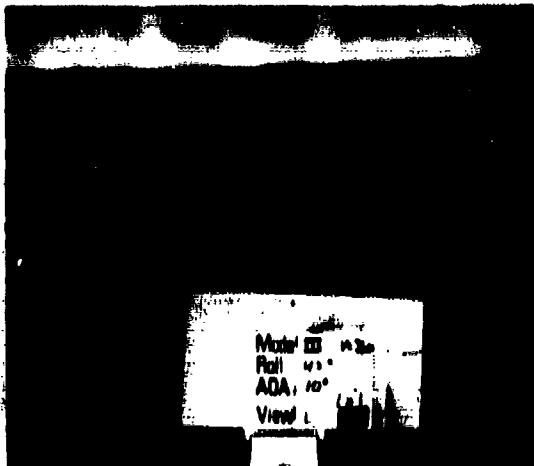
COLUMN 1. MISSILE LEE, 33° ROLL, 20° AOA



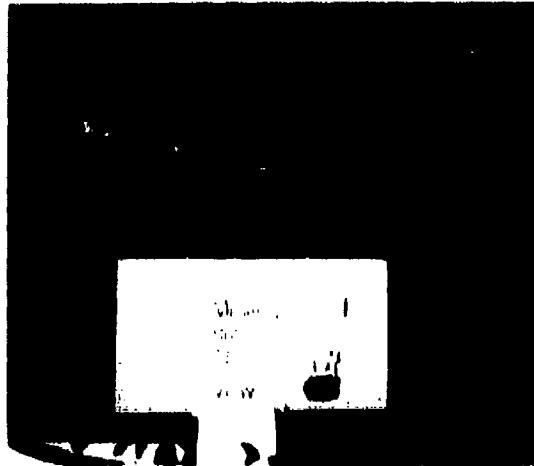
2c. PICTURE F- TOPSIDE VIEW

COLUMN 2. MISSILE LEE, 33° ROLL, 20° AOA

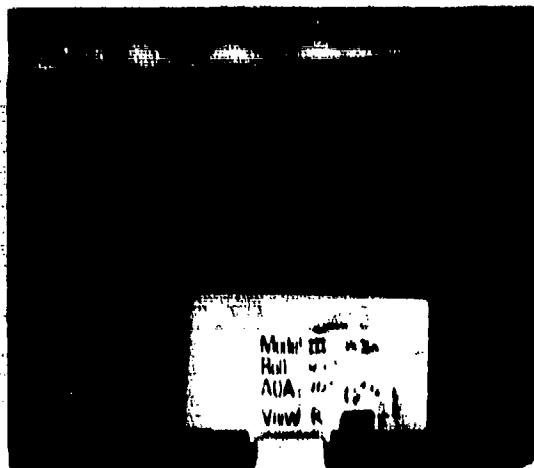
FIGURE E-25 OIL FLOW VISUALIZATION PHOTOGRAPHS



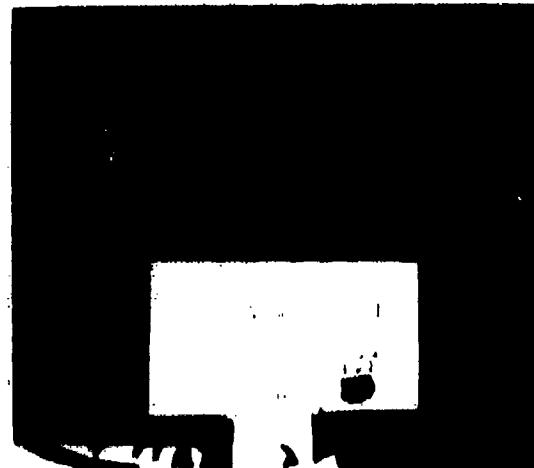
1a. PICTURE A- LEFT SIDE VIEW



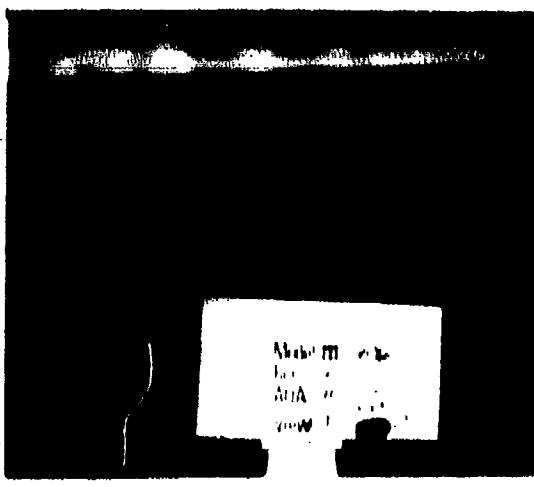
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

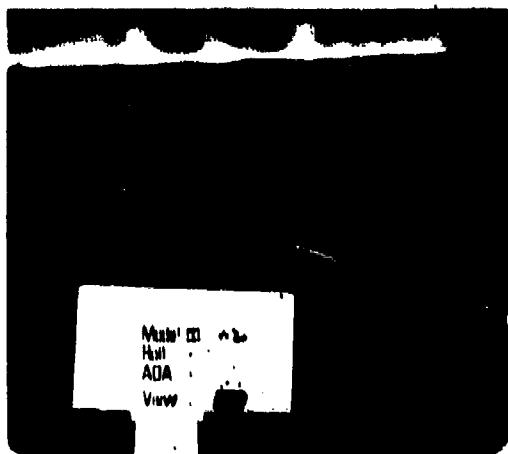
COLUMN 1: MUSCLE 33, 45° ROLL, 10° ADA



2c. PICTURE F- TOPSIDE VIEW

COLUMN 2: MUSCLE 33, 45° ROLL, 10° ADA

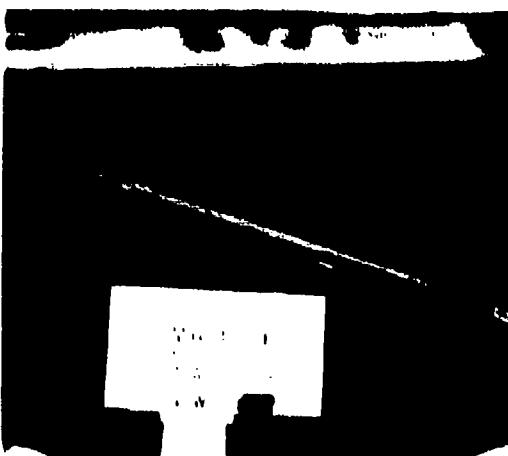
FIGURE E-26 OIL FLOW VISUALIZATION PHOTOGRAPHS



1a. PICTURE A- LEFT SIDE VIEW



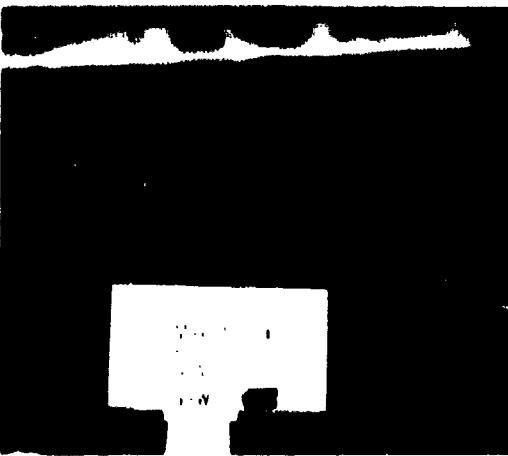
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

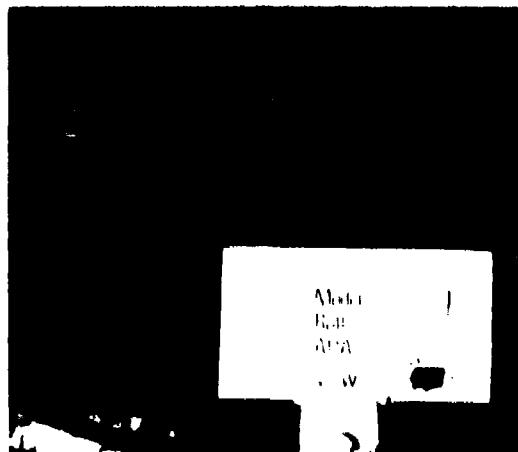


2c. PICTURE F- TOPSIDE VIEW

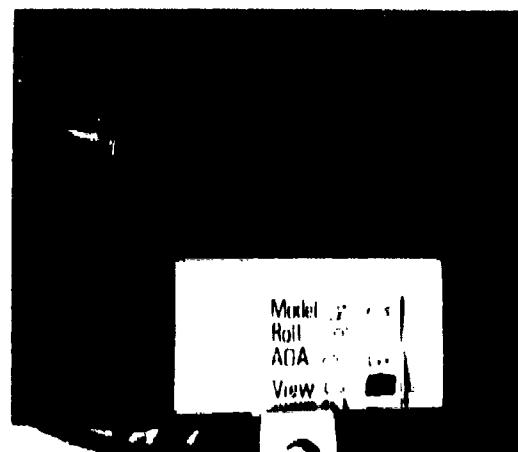
COLUMN 1: MISSILE 111, 45° ROLL, 30° ADA

COLUMN 2: MISSILE 111, 45° ROLL, 15° ADA

FIGURE E-27 OIL FLOW VISUALIZATION PHOTOGRAPHS



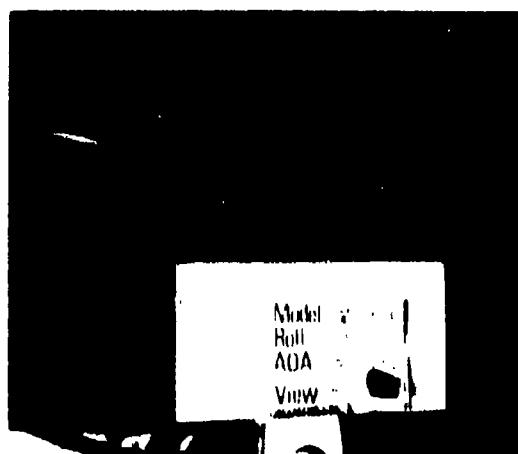
1a. PICTURE A- LEFT SIDE VIEW



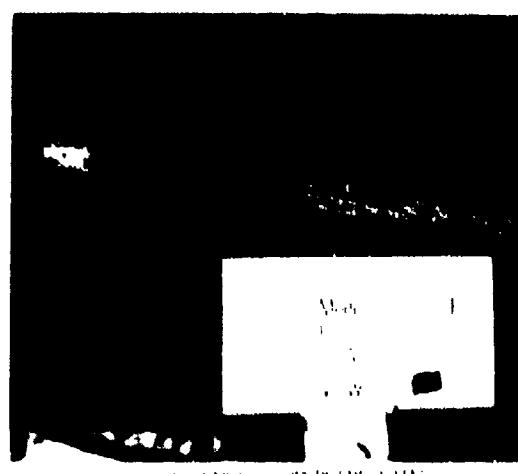
2a. PICTURE D- LEFT SIDE VIEW



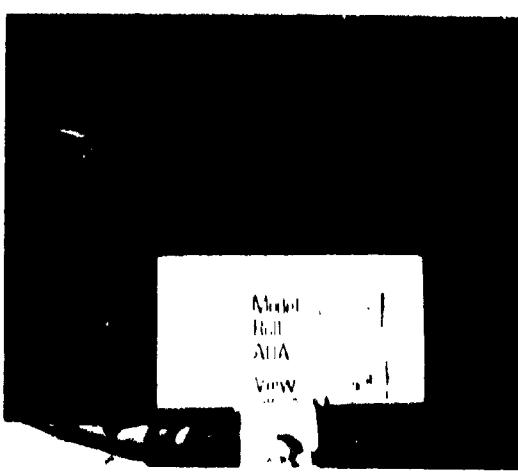
1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOP SIDE VIEW

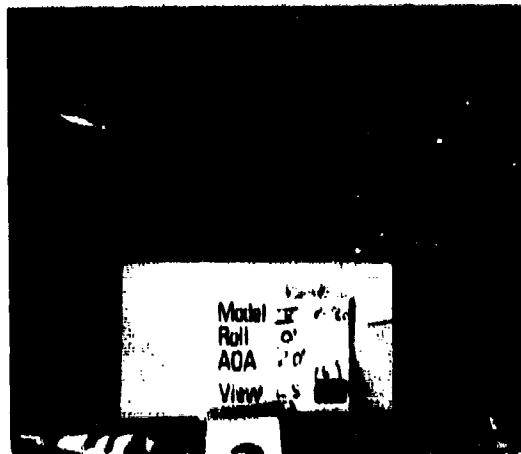


2c. PICTURE F- TOP SIDE VIEW

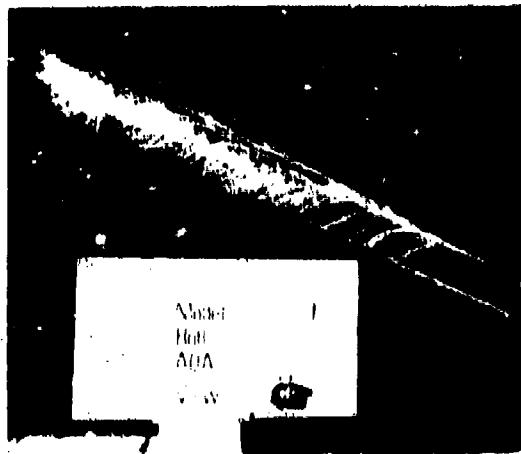
COMING UP: SPOTLIGHT ON ROLLING TO 100%

COMING UP: SPOTLIGHT ON ROLLING TO 100%

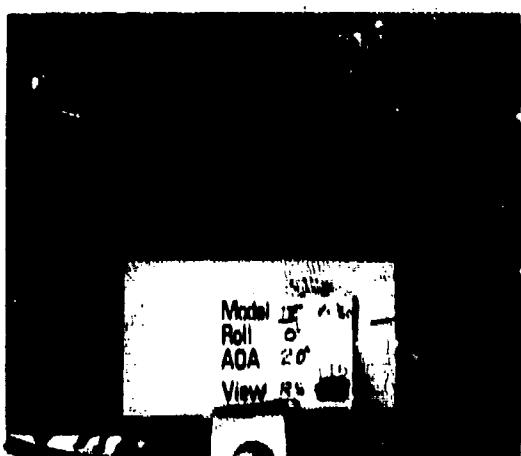
FIGURE E-25 - GEE FLOW VISUALIZATION PHOTOGRAPHS



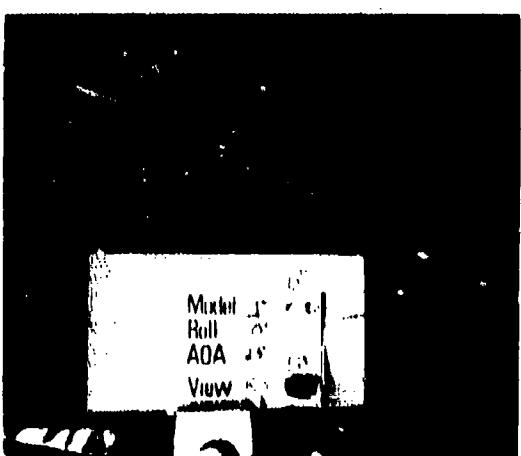
1a. PICTURE A- LEFT SIDE VIEW



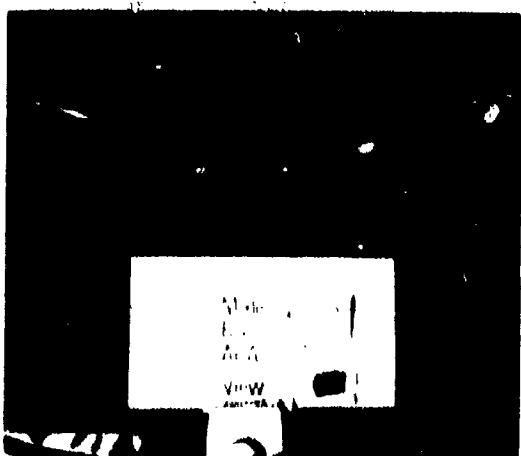
2a. PICTURE D- LEFT SIDE VIEW



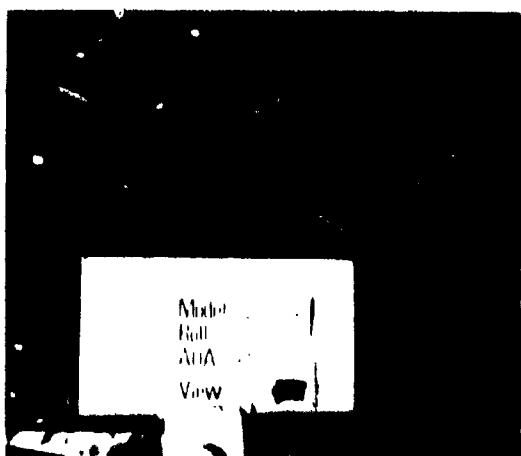
1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

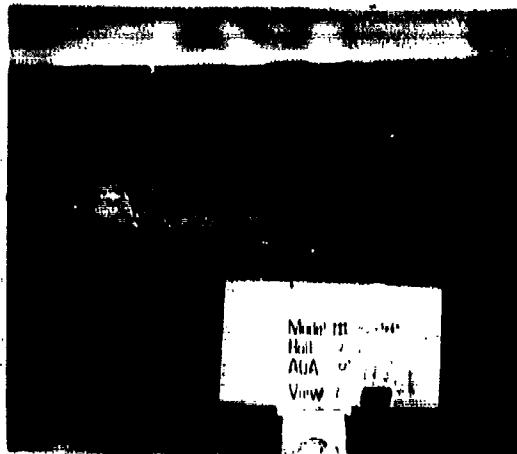


2c. PICTURE F- TOPSIDE VIEW

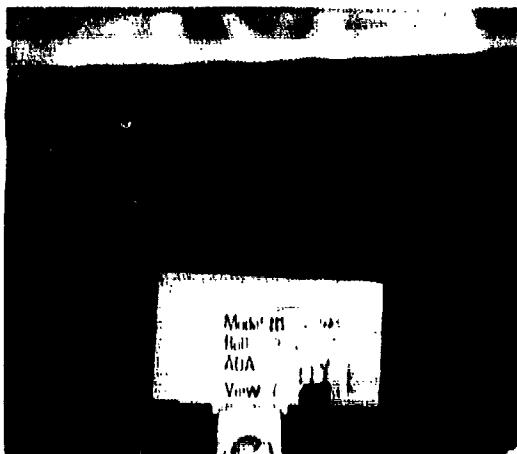
COLLAR 1, MISSILE 1, 0° ROLL, 20° AOA

COLLAR 1, MISSILE 1, 0° ROLL, 20° AOA

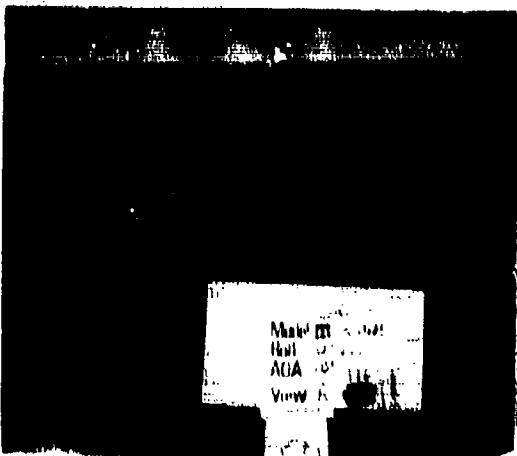
FIGURE E-29. OIL FLOW VISUALIZATION PHOTOGRAPHS



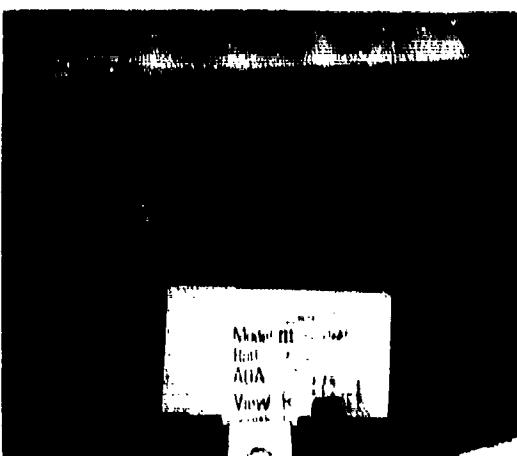
1a. PICTURE A- LEFT SIDE VIEW



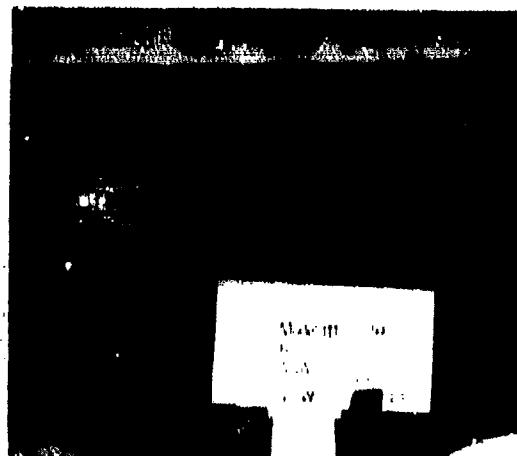
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW

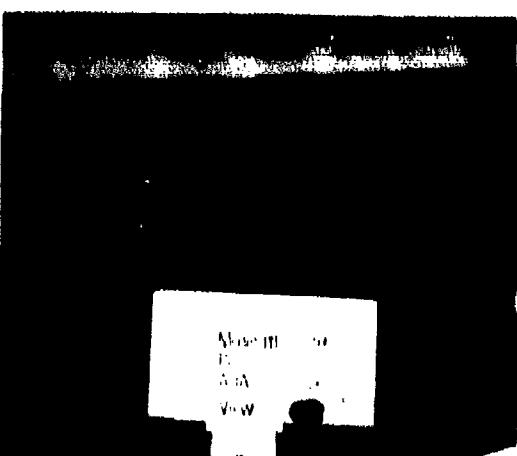


2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

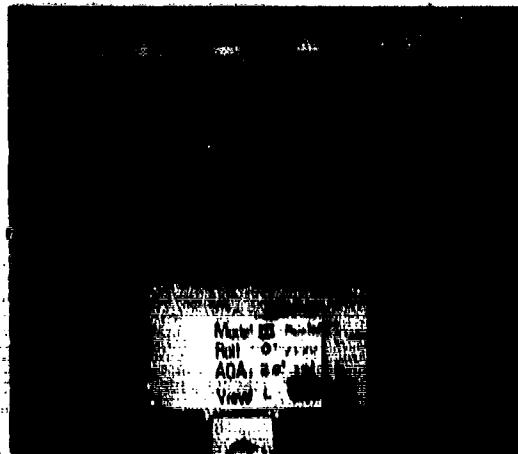
COLUMN 1. MISSILE TILT, 0° ROLL, 20° yaw



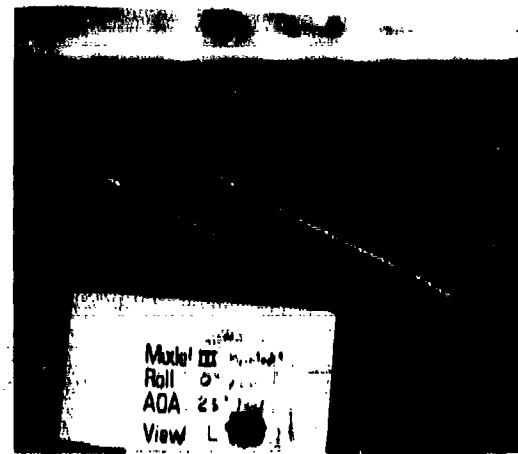
2c. PICTURE F- TOPSIDE VIEW

COLUMN 2. MISSILE TILT, 0° ROLL, 35° yaw

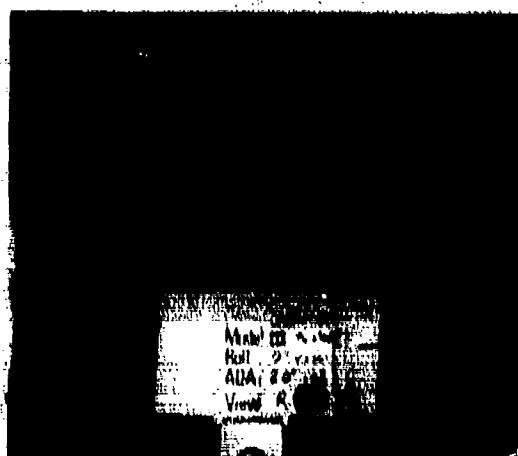
FIGURE E-30. OIL FLOW VISUALIZATION PHOTOGRAPHS



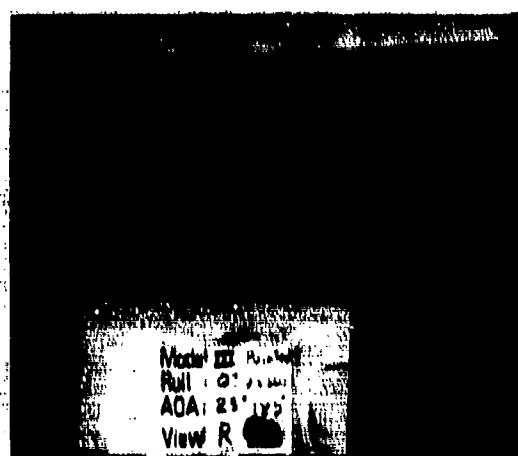
1a. PICTURE A- LEFT SIDE VIEW



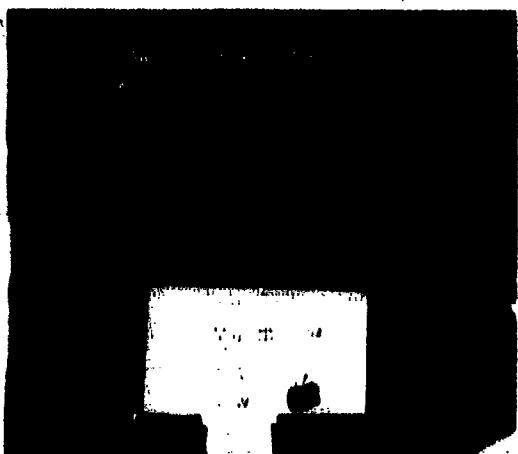
2a. PICTURE D- LEFT SIDE VIEW



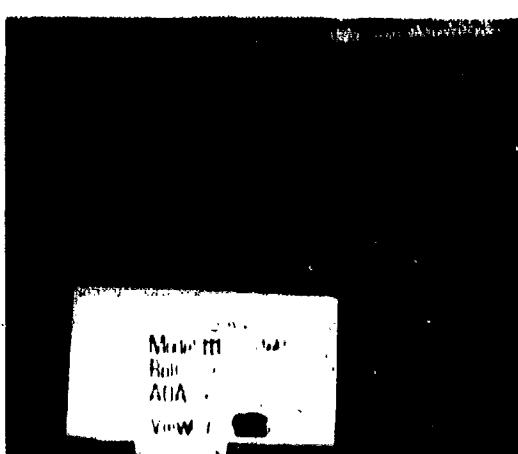
1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

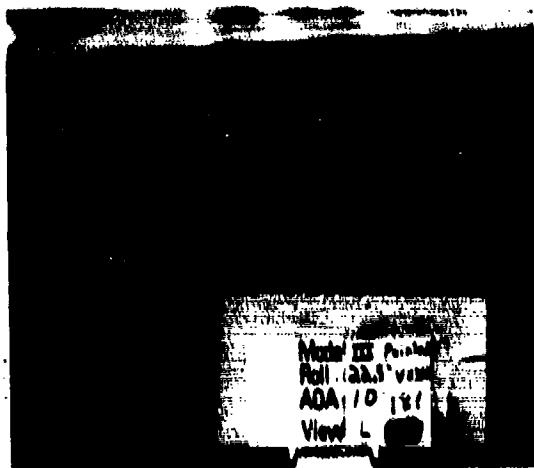


2c. PICTURE F- TOPSIDE VIEW

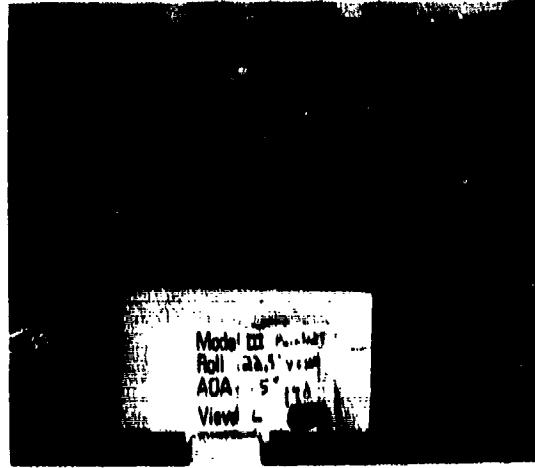
COLUMN 1. MISSILE TILT, 0° ROLL, 10° AOA

COLUMN 2. MISSILE TILT, 0° ROLL, 15° AOA

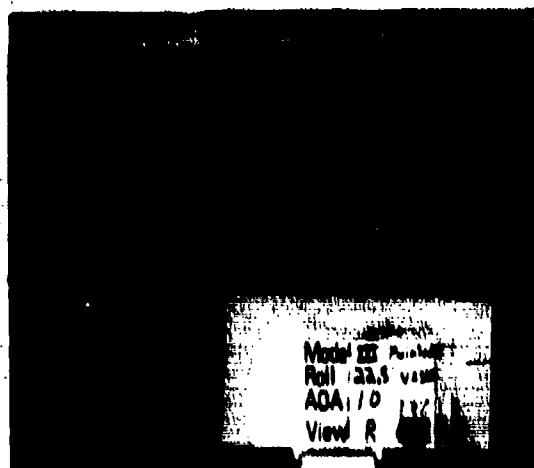
FIGURE E-31 OIL FLOW VISUALIZATION PHOTOGRAPHS



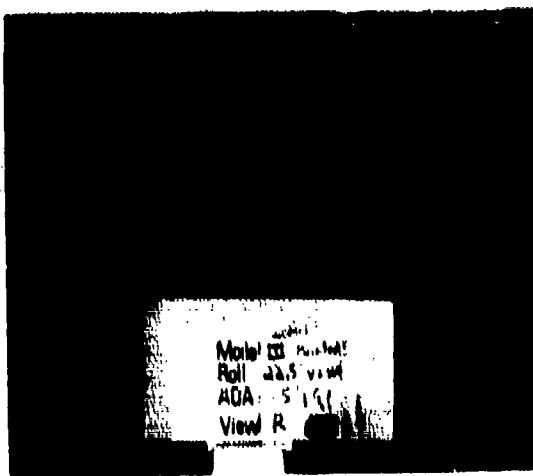
1a. PICTURE A- LEFT SIDE VIEW



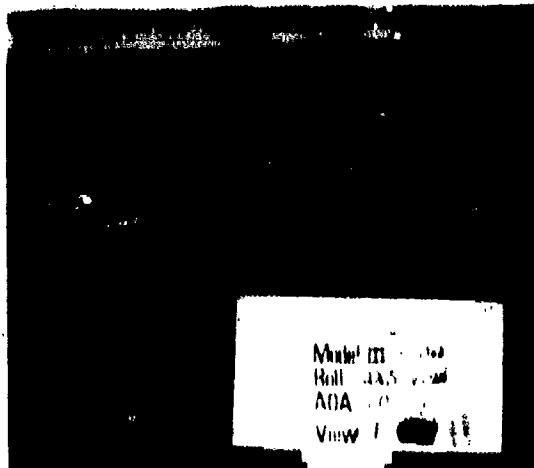
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW

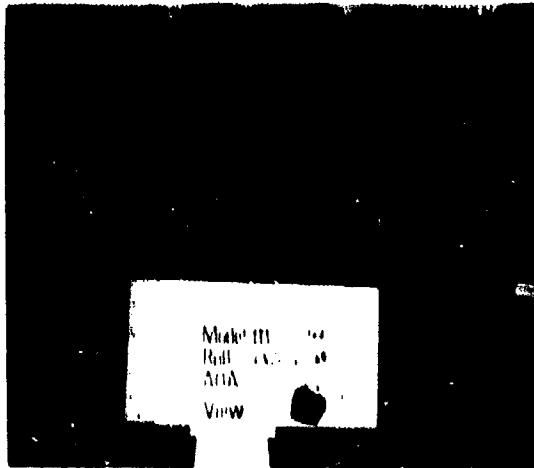


2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

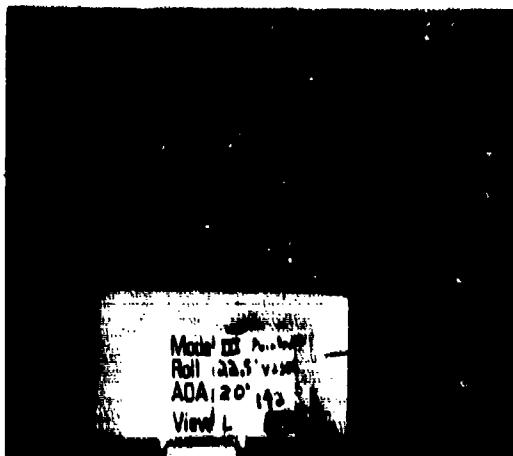
COLUMN 1. MISSILE FIN, 22.5° ROLL, 10° AOA



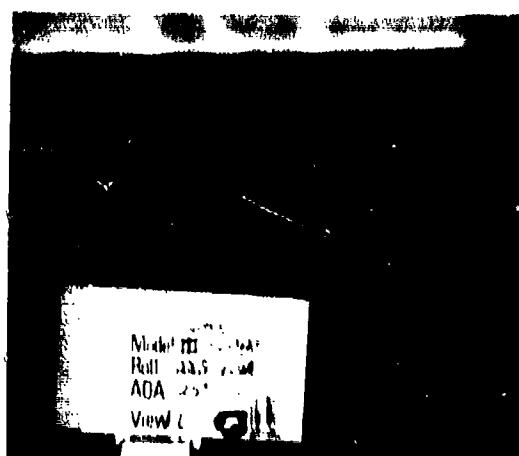
2c. PICTURE F- TOPSIDE VIEW

COLUMN 2. MISSILE FIN, 22.5° ROLL, 5° AOA

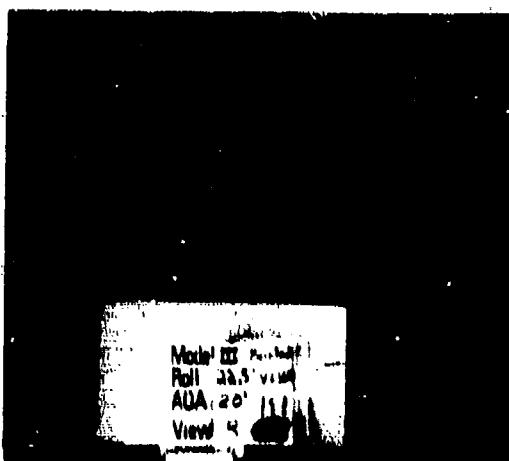
FIGURE E-32. OIL FLOW VISUALIZATION PHOTOGRAPHS



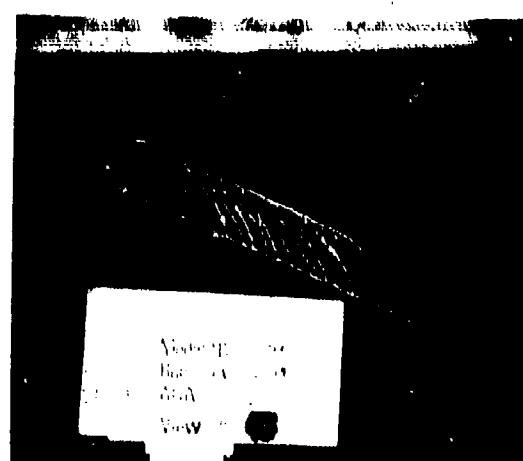
1a. PICTURE A- LEFT SIDE VIEW



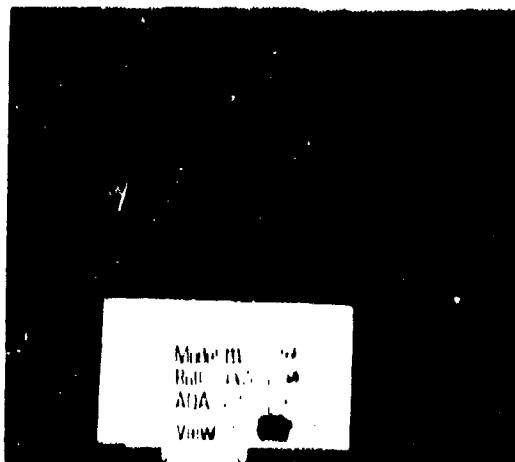
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW

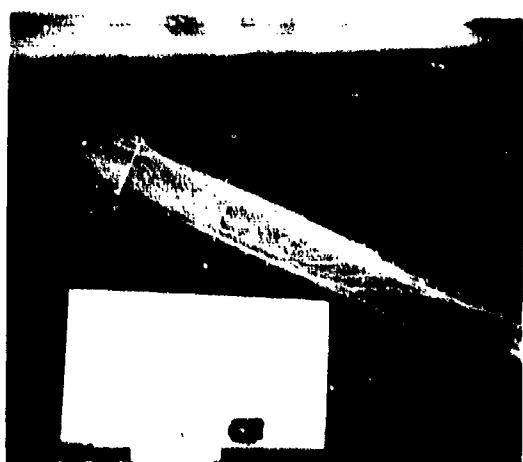


2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

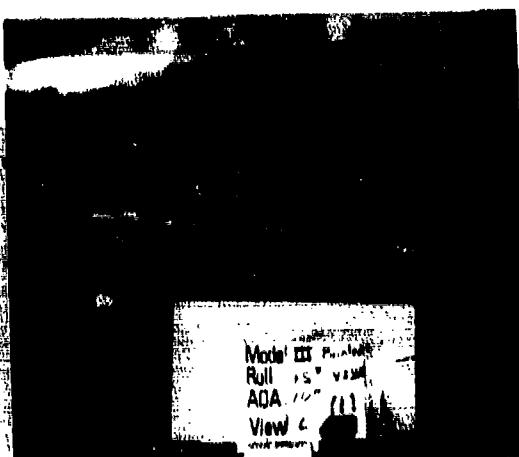
COLUMN 1. MISSILE F1P, 20° ROLL, 20° ADA



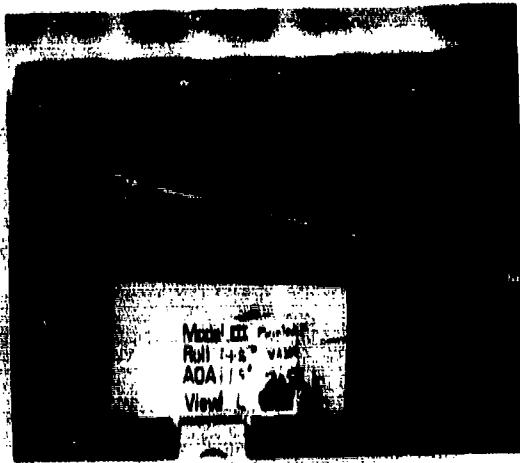
2c. PICTURE F- TOP EDGE VIEW

COLUMN 1. MISSILE F1P, 20° ROLL, 20° ADA

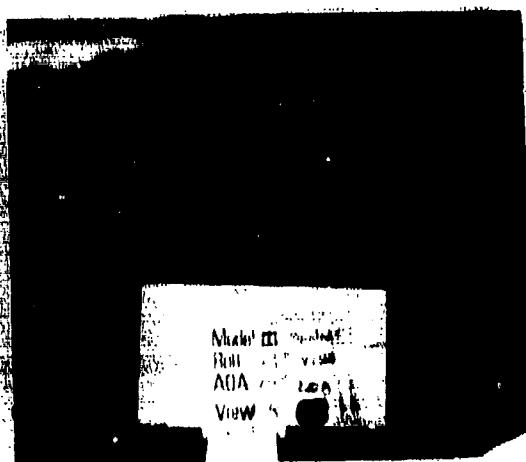
FIGURE E-33. OIL FLOW VISUALIZATION PHOTOGRAPHS



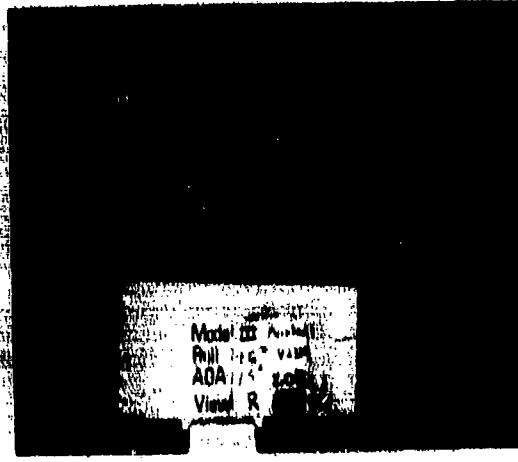
1a. PICTURE A- LEFT SIDE VIEW



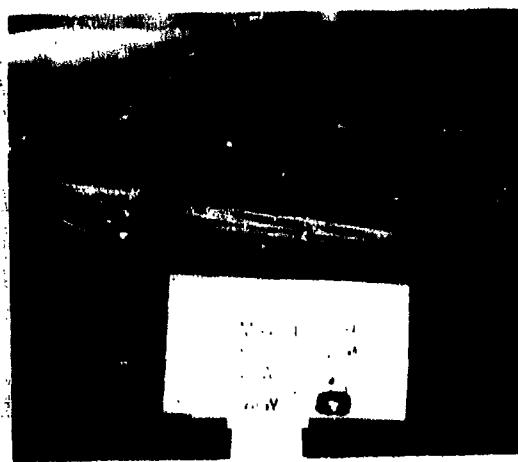
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW

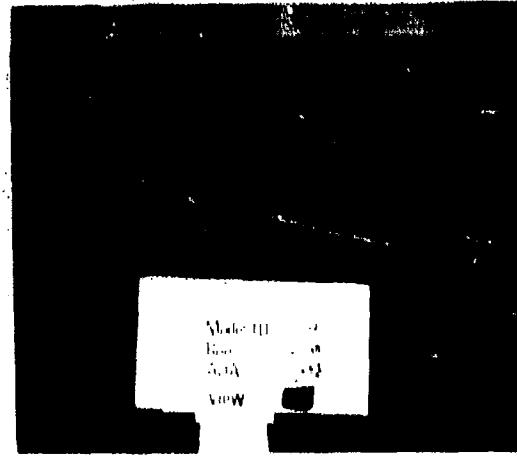


2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

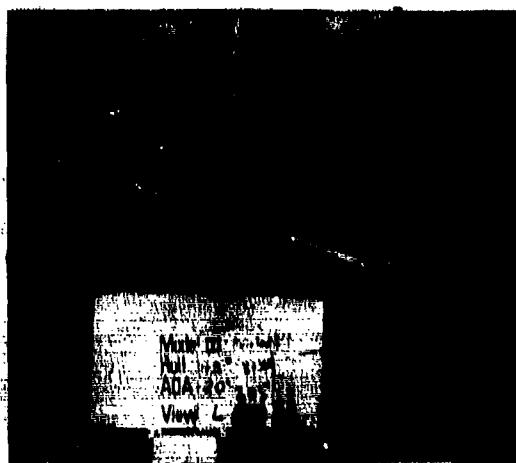
COLUMN 1. MISSILE 111P, 45° ROLL, 10° AOA



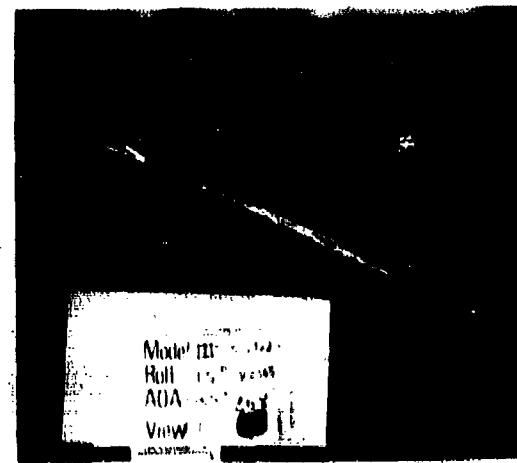
2c. PICTURE F- TOPSIDE VIEW

COLUMN 2. MISSILE 111P, 45° ROLL, 15° AOA

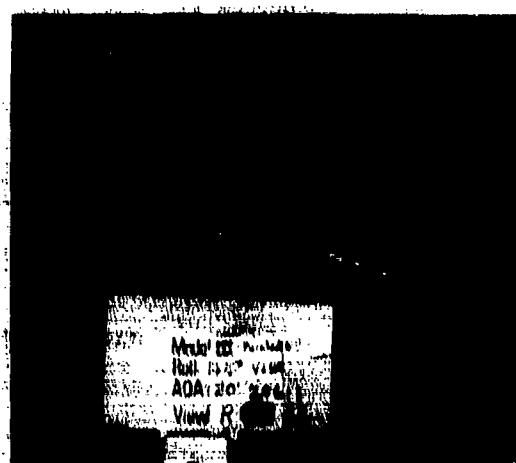
FIGURE E-34 OIL FLOW VISUALIZATION PHOTOGRAPHS



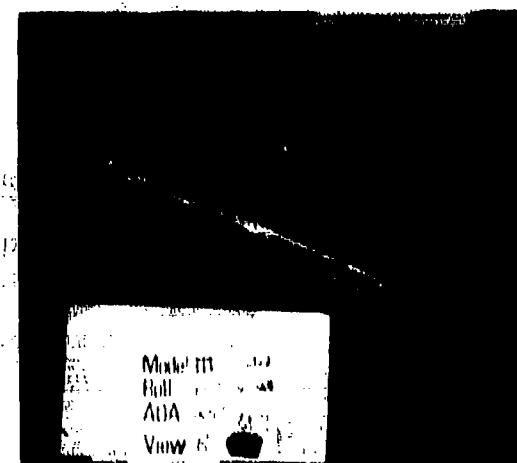
1a. PICTURE A- LEFT SIDE VIEW



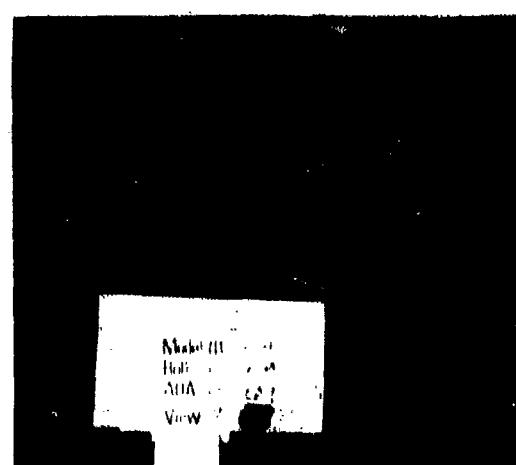
2a. PICTURE D- LEFT SIDE VIEW



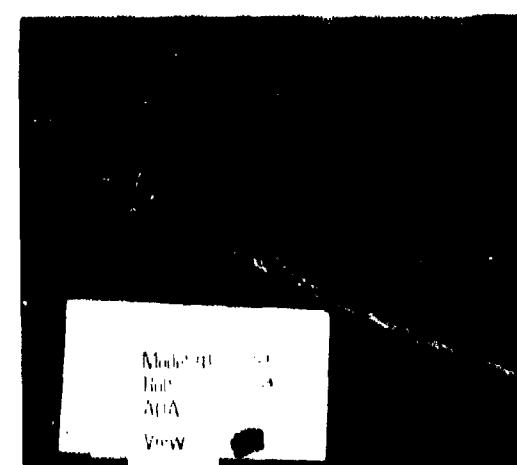
1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW



2c. PICTURE F- TOPSIDE VIEW

COLUMN 1. MISSILE TILT, 45° ROLL, 20° AOA

COLUMN 2. MISSILE TILT, 45° ROLL, 25° AOA

FIGURE E-35 OIL FLOW VISUALIZATION PHOTOGRAPHS



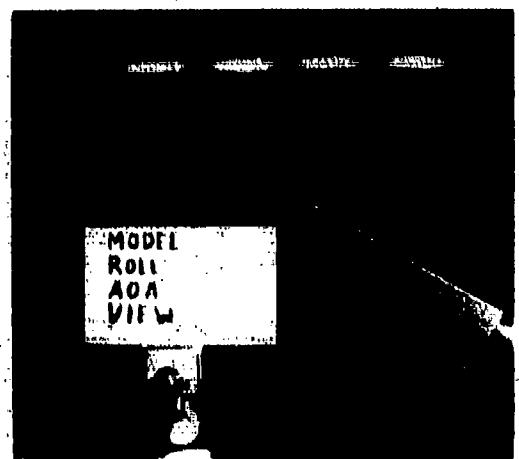
1a. PICTURE A- LEFT SIDE VIEW



2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

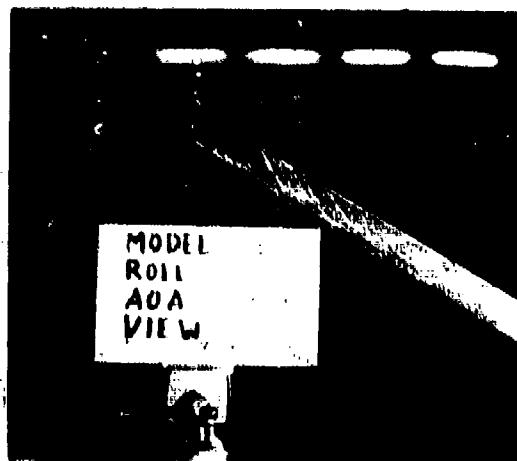


2c. PICTURE F- TOPSIDE VIEW

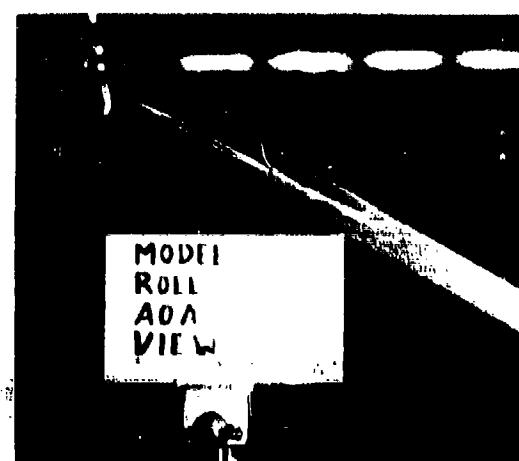
COLUMN 1: MODEL 1, 0° ROLL, 10° AOA

COLUMN 2: MODEL 1, 22° ROLL, 10° AOA

FIGURE E-3E OIL FLOW VISUALIZATION PHOTOGRAPHS



1a. PICTURE A- LEFT SIDE VIEW



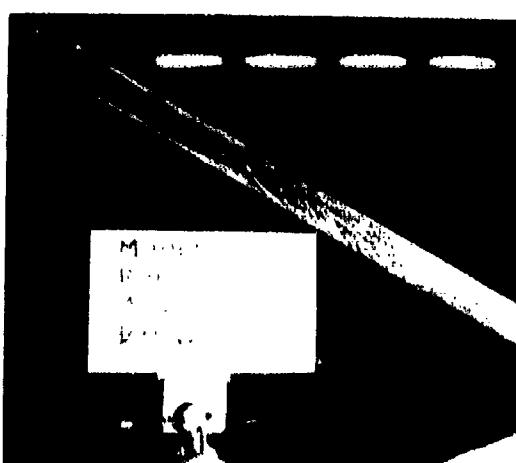
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW

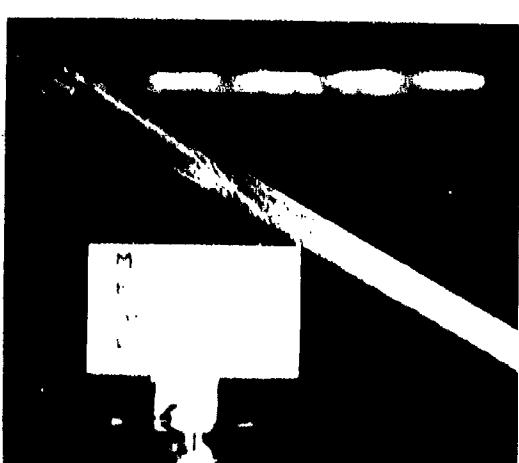


2b. PICTURE E- RIGHT SIDE VIEW



3a. PICTURE C- TOPSIDE VIEW

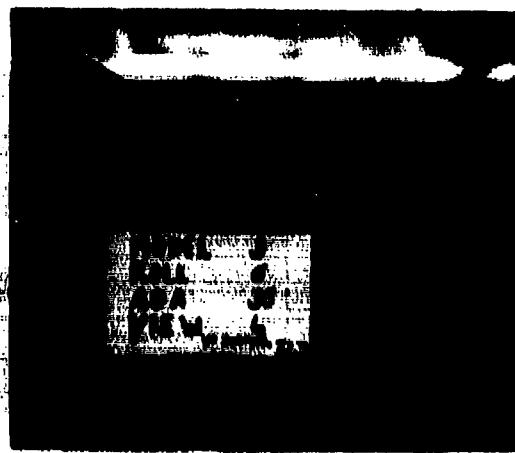
COFFEE 100, MUSCLE 100, 0% ROLL, 30° AOA



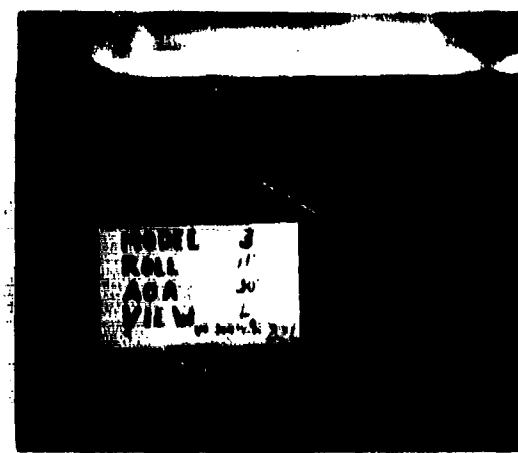
3b. PICTURE F- TOPSIDE VIEW

COFFEE 100, MUSCLE 100, 0% ROLL, 30° AOA

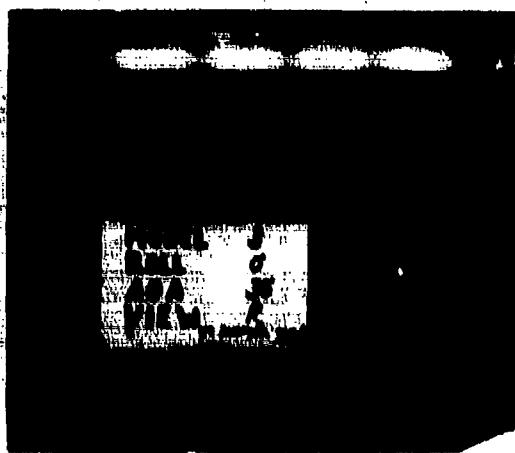
FIGURE E-37. OIL FLOW VISUALIZATION PHOTOGRAPHS



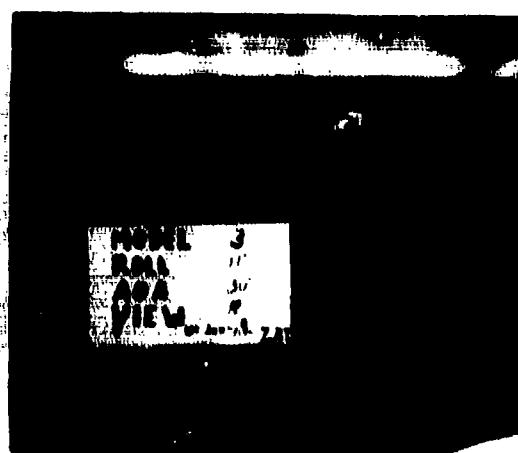
1a. PICTURE A- LEFT SIDE VIEW



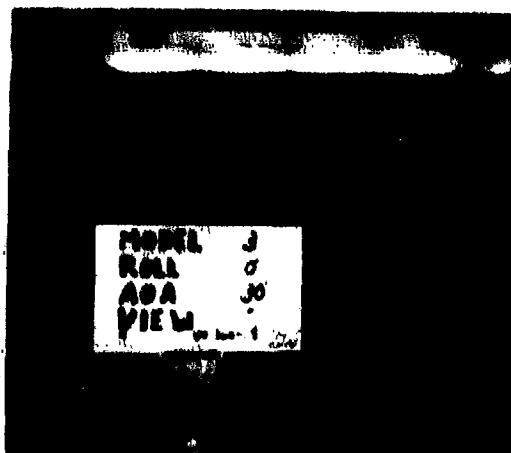
2a. PICTURE D- LEFT SIDE VIEW



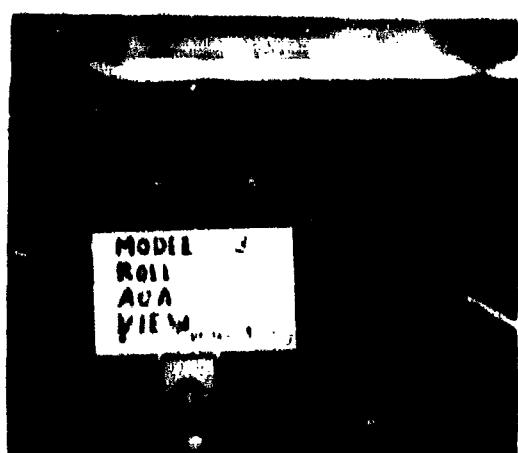
1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- INSIDE VIEW

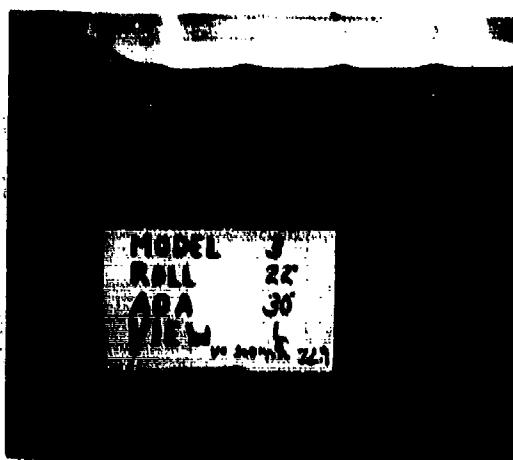


2c. PICTURE F- TOP END VIEW

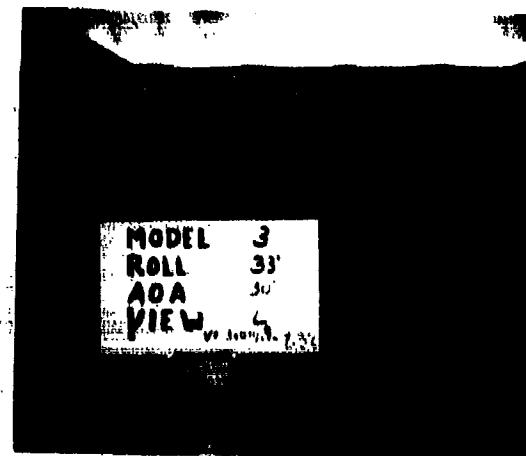
FIGURE E-38. MODEL J, 6" ROLL, 30° AOA

FIGURE E-38. MODEL J, 6" ROLL, 30° AOA

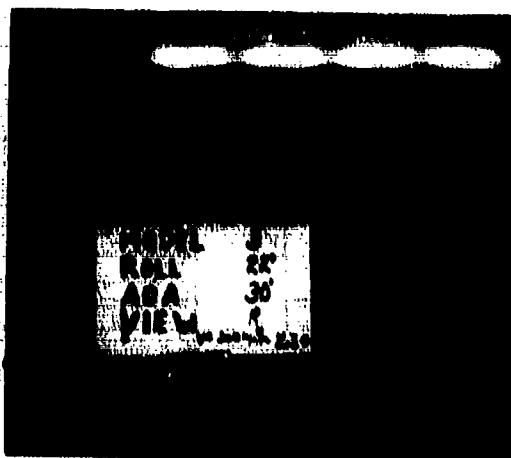
FIGURE E-38. OIL FLOW VISUALIZATION PHOTOGRAPHS



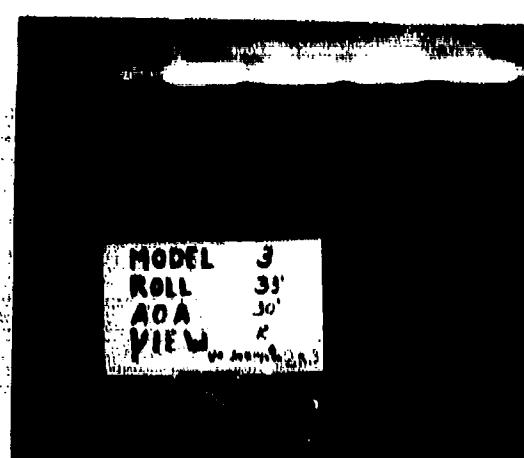
1a. PICTURE A- LEFT SIDE VIEW



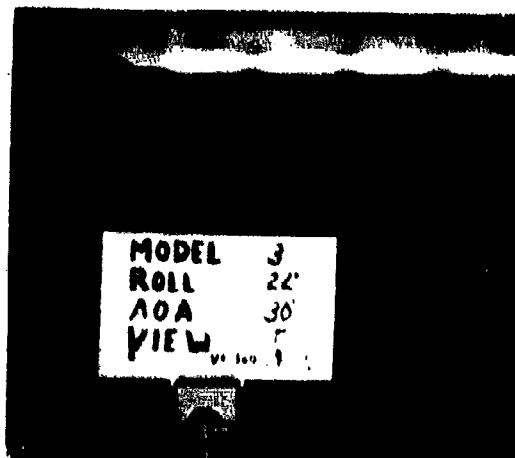
2a. PICTURE D- LEFT SIDE VIEW



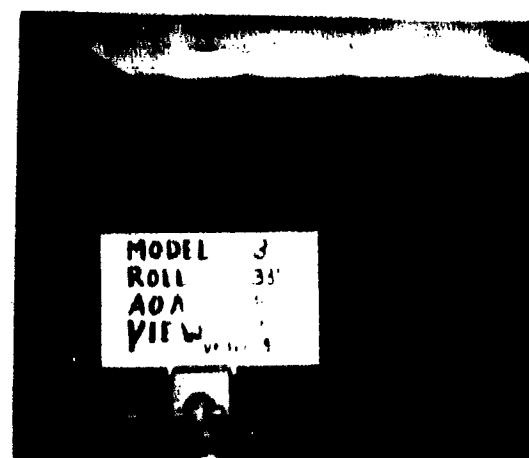
1b. PICTURE B- RIGHT SIDE VIEW



2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

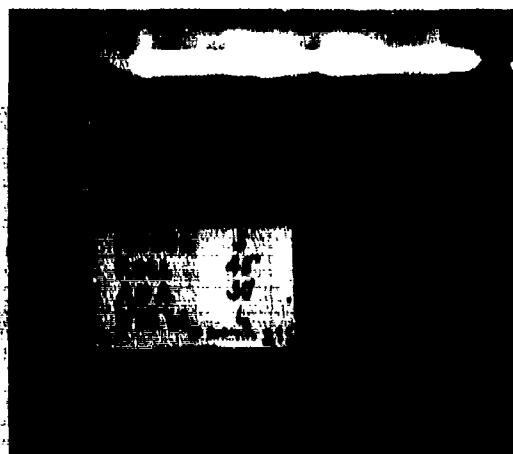


2c. PICTURE F- TOPSIDE VIEW

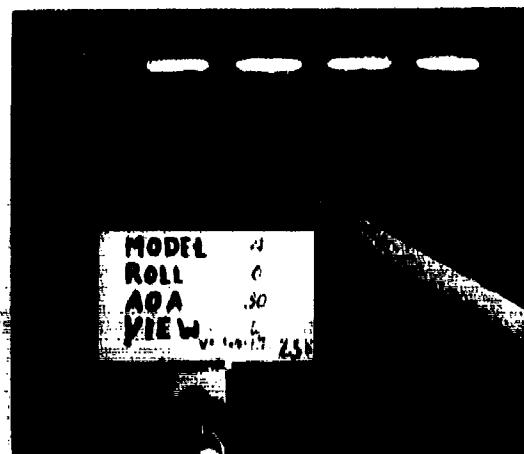
COLLAR 1, MIDDLE 1, 22° ROLL, 30° AOA

COLLAR 1, MIDDLE 1, 33° ROLL, 30° AOA

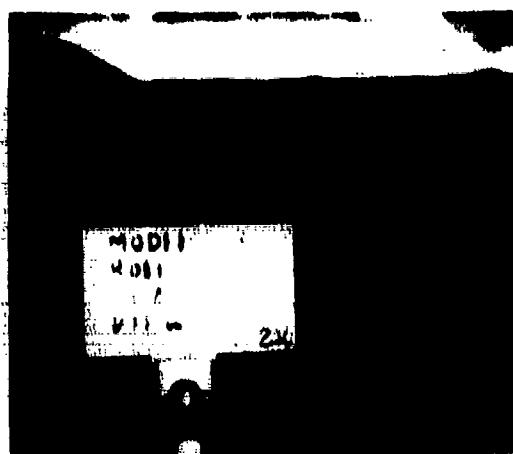
FIGURE E-39 OIL FLOW VISUALIZATION PHOTOGRAPHS



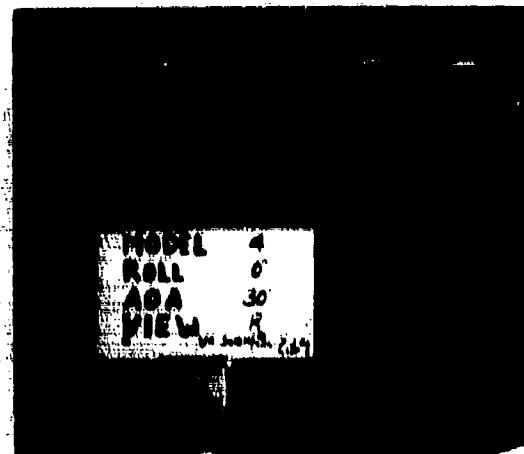
1a. PICTURE A- LEFT SIDE VIEW



2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW

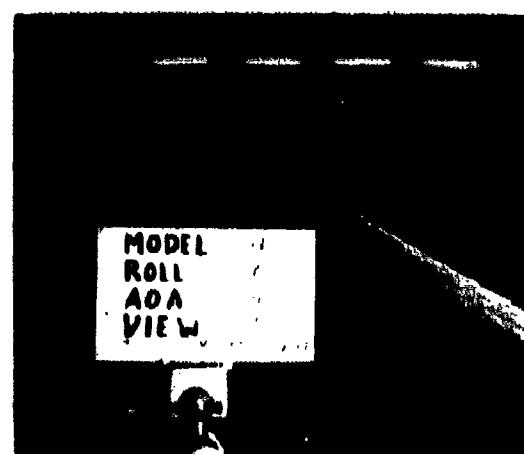


2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

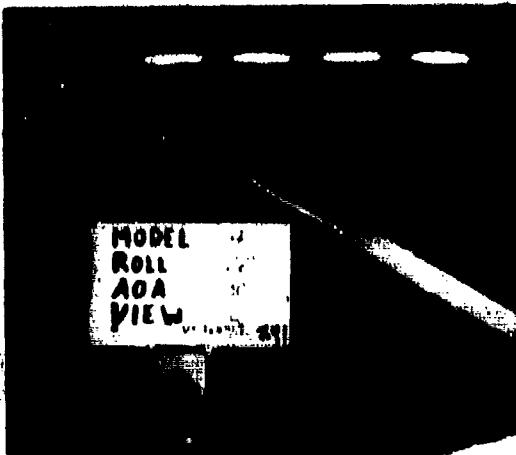
COLUMN 1. MISSILE 3, 45° ROLL, 30° AOA



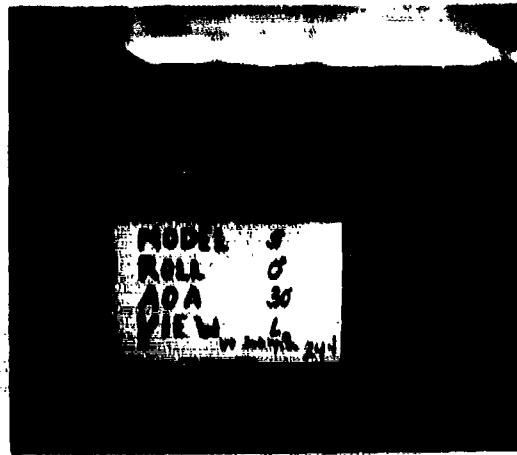
2c. PICTURE F- TOPSIDE VIEW

COLUMN 2. MISSILE 4, 0° ROLL, 30° AOA

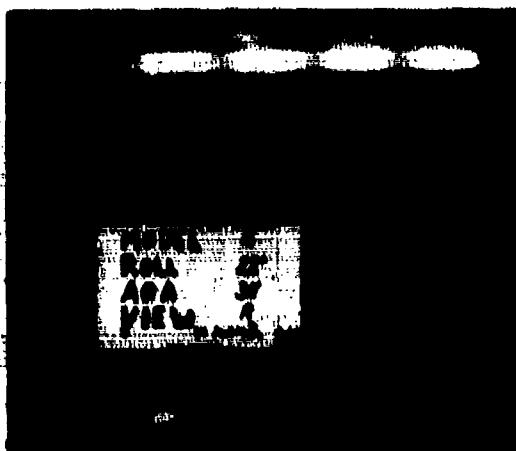
FIGURE E-40 OIL FLOW VISUALIZATION PHOTOGRAPHS



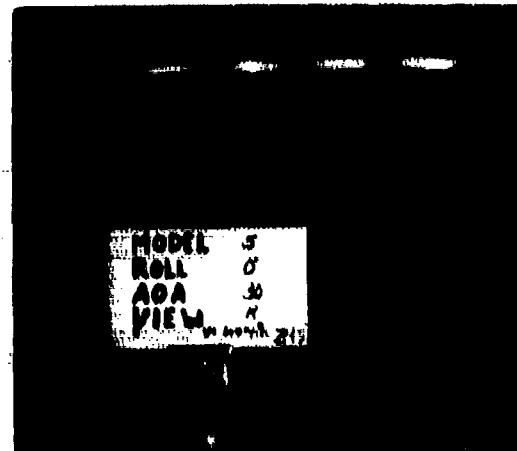
1a. PICTURE A- LEFT SIDE VIEW



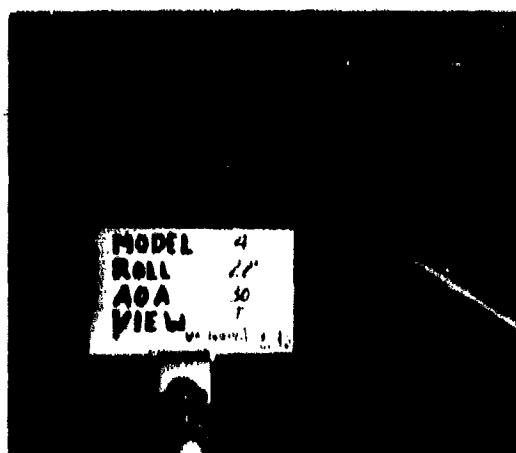
2a. PICTURE D- LEFT SIDE VIEW



1b. PICTURE B- RIGHT SIDE VIEW

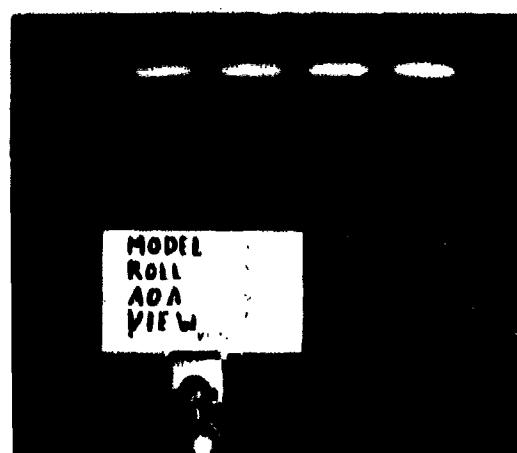


2b. PICTURE E- RIGHT SIDE VIEW



1c. PICTURE C- TOPSIDE VIEW

COLUMN 1. MISSILE 4, 22° ROLL, 30° AOA



2c. PICTURE F- TOPSIDE VIEW

COLUMN 2. MISSILE 5, 0° ROLL, 30° AOA

FIGURE E-41. OIL FLOW VISUALIZATION PHOTOGRAPHS

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